JPRS-CST-85-027

22 August 1985

China Report

SCIENCE AND TECHNOLOGY

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS-CST-85-027

22 August 1985

CHINA REPORT

SCIENCE AND TECHNOLOGY

CONTENTS

PEOPLE'S REPUBLIC OF CHINA

NATIONAL DEVELOPMENTS

ABSTRACTS

NATIONAL DEVELOPMENTS

CRITIQUE ON 'FOURTH WORLD INDUSTRIAL REVOLUTION'

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 5, 12 Apr 84 pp 8-9

[Article by Qian Xuesen [6929 1331 2773]]

[Text] What Messages?

Last April, the American Kotulak wrote an article that was much more low-key than Toeffler's and without mentioning the bright future of capitalist world. Instead, it was permeated with a sense of crisis. However, it emphasized the importance of intelligence and knowledge, which is worth looking into further.

It has become routine for Western capitalist nations to claim a new "scientific and technological revolution" and new "industrial revolution" in an effort to give a shot in the arm to the troublesome and deteriorating capitalist system. It is said that Marxism no longer works because there was no such revolution at the time of Marx and Engels. Now capitalism will last forever. The more recent example is "The Third Wave" by Toeffler, the journalist turned sociologist, in 1980, in which it was claimed that computers, genetic engineering, new materials for structural purposes and ocean exploitation would solve all the problems of their countries and bring about the reflourishing of the Western world. I have commented on Toeffler's views (see "World Economic Report," section 2, 19 April 1982). In general, Toeffler's rationale is not sound but some new S&T developments he mentioned will have great impact on the creation of material wealth and should not be ignored.

Three years later on 10 April, Robert Kotulak's "Science and Industry Look to the Fourth Industrial Revolution" appeared in the CHICAGO TRIBUNE. Kotulak's tone was somewhat different from Toeffler's and was much more low-key. Although it still covered the microprocessor in computers, genetic engineering, new materials, energy development, etc., this time the bright future of the capitalist world was not mentioned and it was permeated with a sense of crisis. It said that American education faced the challenge of the "fourth world industrial revolution" (this is inaccurate because he unjustifiably divided the industrial revolution at the turn of 19th century into two industrial revolutions and regarded the development of electricity, chemicals and cars at the turn of this century as "the third

industrial revolution"), that the reason that the United States could not compete with Japan and West Germany was because of the defection of high school and college teachers to industries and enterprises for better pay. As a result, the quality of teaching was poor and graduates were ill-prepared for the "fourth world industrial revolution" and eventually the United States would suffer serious defeat at the hands of Japan and West Germany. The importance of human intelligence and knowledge were emphasized. The importance he emphasized is worth looking into further and this is the useful message from the so-called "fourth world industrial revolution."

Intelligence and Knowledge Are Productive Forces

In this age of computers, automatic control, genetic engineering, new materials and new energy sources, the labor skill of the production worker will be based on intelligence and knowledge rather than physical labor. This is a significant change in the social development of mankind because the difference between physical and mental labor, one of the three major differences taking shape through thousands of years, is finally diminishing.

Therefore, the first essential element of productive forces shall be revised as "workers with certain production experience, labor skill, intelligence and knowledge."

What constitutes productive forces? According to classical theories, the essential elements of productive forces are:

(1) workers with certain production experience and labor skill;

(2) means of labor based mainly on production tools.

Some added the third element as the subject of labor. We are going to put this issue aside for the moment by saying that the productive forces according to classical theories consist of two elements: workers and means of production.

Today, the classical theories on productive forces have to be expanded. First, don't we say that S&T are productive forces? So they should be included. Without S&T, productivity cannot be raised. This is described in a lively manner in Chinese villages today. Farmers call S&T personnel in agriculture the "gods of wealth." Another important point is that we cannot consider S&T as natural sciences because part of productivity also includes organization and management of production systems. That is why Comrade Deng Liqun [6772 0500 5028] said: "When mentioning science, many comrades tend to think that it means natural sciences and does not include social sciences. In the past, due to various reasons, there was some truth in this kind of understanding. But after the 12th CPC Congress, to see and try to solve problems with the same understanding should be described as outdated" (see "Trends of Economics," Vol 1 1983 p 1).

The so-called "fourth world industrial revolution" also reveals the following question: to advance S&T, strong teams for the research and development

of S&T are necessary. But to turn S&T achievements into productivity requires people who know how to apply these achievements. This is to say that not only high-caliber researchers are needed in S&T research institutions, but many qualified engineers, scientists and management experts are also needed in production organizations and enterprises. Furthermore, in this age of computers, automatic control, genetic engineering, new materials and new energy sources, production workers are different too. Their labor skills are no longer based on physical labor but instead on intelligence and knowledge. They are "experts" and intellectuals too. Therefore, the first element of productive force should be revised as "workers with a certain production experience, labor skill, intelligence and knowledge." It is unprecedented in human history to impose such high and generalized requirements of intelligence and knowledge on people. It is a significant change in the social development of mankind. The difference between physical and mental labor, one of the three major differences taking shape during thousands of years since the collapse of primitive commune system, finally is diminishing.

Under such an impact, there is an on-going debate in the United States on how to improve the quality of education. Some of the opinions on American high school education reform brought forth in the debate are noteworthy. Examples are:

1. A lower minimum age requirement for elementary school so that 4-year-olds can start formal education and graduate from high school by 16.

2. Reduce the size of high schools so that each school averages no more than 300 students and 12 teachers.

3. Require high school students to take 4 years of literature (English), 3 years of mathematics, 3 years of natural sciences, 3 years of social sciences and 1 1/2 years of computer training. Those who intend to go to college should take one foreign language for at least 2 years.

4. High school students should have a 7-hour day and 220 school days per school year rather than the current 6-hour day and 180 days per school year.

5. Raise college admission standards.

6. Reward outstanding teachers by adopting the "elite teacher" system in high school. Elite teachers should have doctoral degrees and be paid higher than average teachers.

7. Raise the qualifications of teachers and administer competency tests to teachers regularly.

The debate on education reform is still going on. In a speech given this May, Secretary of Education Bell said that improvement of public education would be an important issue in the 1984 presidential campaign.

What Shall We Do?

The trend of modern science, technology and production development dictates that, from the aspect of intelligence exploitation, college education be popularized among people, otherwise the modernized production in the future or in early 21st century will not be achieved.

Can we consider that by the year 2000 all cadres will be college graduates majoring in the fields they are in, all cadres at department head and division commander level will have masters degrees and all cadres at minister and army commander level will have doctoral degrees?

There are always a course when events develop. Currently, it seems that doctoral degree holders have higher social status than professors in our country. In modern advanced countries, graduates of 4-year college are only qualified for general tasks. It is impossible to do advanced work without the training of a masters or doctoral degree. However, for research or college teaching, doctoral degree holders only meet the requirements for junior research staff members or lecturers. It takes years of practical training to reach the level of senior engineer, scientist and full professor. This situation has lasted for several decades since the turn of the century, exemplifying the importance of culture and knowledge in modern society. Now because of the so-called "fourth world industrial revolution," it has to be pushed further by requiring that a certain percentage of the working population be college graduates. In the meantime, many masters and doctors should be trained. Without such intelligence exploitation, the modernized production in the future and in early 21st century will not be achieved. What's next then? All the people are required to get a college education when some of them reach the level of master and doctor, i.e., to popularize college education.

These are dictated by the trend of modern science, technology and production development. What would be the situation if the advanced nations meet the requirements and we do not? Then our productivity would lag far behind the advanced nations of that time. Would our people be satisfied then? Could we claim that we have built a modern socialist nation with advanced material and spiritual civilization? It would be a great achievement to quadruple our productivity by 2000. But it would be even harder later on. We ought to realize this and be prepared.

Can we suggest that, as a first step, all cadres will be graduates of 4-year college, all cadres at department head and division commander level have masters degrees and all cadres at minister and army commander level have doctoral degrees by the year 2000? To fully utilize their experience, the leading cadres can either do research or teach at institutions of higher learning after their retirement at 50 or 60. Of course, compared with our current situation, these requirements seem very high. But, when compared with the aforementioned trend of modern science, technology and production development, they seem not enough.

Long-Term Planning Is Necessary

To greet and prepare for the coming of 21st century involves total cultural construction and total socialist spiritual civilization construction, which inevitably involve economic construction and socialist material civilization construction. We ought to seriously consider abolishing the difference between physical and mental labor.

Earlier, the issue of education was only briefly discussed and was not thorough. And the quality of teaching and educational systems were not addressed. To greet and prepare for the coming of 21st century, things that ought to be done are not limited to education, according to the messages from the so-called "fourth world industrial revolution." Others include S&T, literature and art, books and magazines and information as well as the establishment of information networks. These involve the whole cultural construction and whole socialist spiritual civilization construction, which inevitably involve economic construction and socialist material civilization construction. The general policies till the end of this century have been determined at the 12th CPC Congress. Together with the agricultural issue and the energy, transportation issue, the education and science issue has been listed as one of the three major strategic measures. Now is the time to draw up a specific plan, taking into consideration the tasks of the early 21st century. When doing this task, what have been discussed above probably are valuable for reference purposes. We ought to seriously think about the issue of abolishing the difference between physical and mental labor. These are the lessons of the so-called "fourth world industrial revolution."

12922
CSO: 4008/343

NATIONAL DEVELOPMENTS

TWO SCIENCES COMBINED TO SERVE ECONOMIC CONSTRUCTION

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 5, 12 Apr 84 pp 18-20

[Article by Gu Shixian [7357 0013 7359]]

[Text] With its vast developmental potential, the coastal zone is a mix of nature and economy. Resource development is a socioeconomic issue and the ratio of investment and return, i.e., economic benefit, which also coincides with ecological benefit, has to be considered. When ecological benefits are endangered, it is difficult to maintain economic benefits. It is not sufficient to rely merely on the multidisciplinary, comprehensive studies of natural sciences. With respect to coastal zone resources surveys, the lateral connection of natural and social sciences has to be strengthened and attempts must be made to get results from the overlapping areas of the two major branches of knowledge. In this article, some simple views in this regard are presented. Comments and opinions are more than welcome.

1. The Increasing Integration of Natural and Social Sciences Is an Inevitable Trend

Under the current new situation of the new period, some of our renowned scientists have strongly advocated lateral linkages among branches of science. Prof Tan Jiazhen [6151 1367 2823] proposes that social scientists and natural scientists should form an alliance. He further suggests that the issue of alliance of the two should be understood in the light of the construction of "two civilizations" brought forth at the 12th CPC Congress. Now it can be said that the increasing integration of natural and social sciences is an inevitable trend.

First, based on the characteristics of modern S&T development:

The characteristics of modern S&T development is the socialization of science and the orientation of society to science. The socialization of science is manifested in that modern S&T is being increasingly collectivized and internationalized rather than individualized as before. The Apollo Project of the United States is one form of nationalization. At present, Japan, the United States and Canada have formed a multinational deep-sea mining company to carry out test mining of manganese nodules and five consortia

have been involved in technology and investment. This is another form of internationalization. These occurrences are the results of the complex and comprehensive nature of modern S&T. It is also apparent that the interdependence, mutual penetration and mutual enhancement between precise natural sciences and scientific social sciences is an inevitable and growing trend.

Second, based on the overlapping areas of the two major branches of knowledge:

Through modernized large-scale production, S&T have achieved broader and deeper developments. On the one hand, from the point of view of the laws of the natural sciences, it is exploring the possibility of new technologies and methodologies. On the other hand, from the point of view of the laws of the social sciences, it is studying the feasibility of these methodologies and technologies. Thus, natural and social sciences have penetrated simultaneously into S&T with the latter serving as the link and bridge to closely connect the two. At the same time, systems science has become an increasingly important factor for linking all domains of knowledge. On application, it is linked to control theory, and, on theoretical study, it is linked to information theory. These "three theories" have been widely applied to explore the rules on organization, function and evolution of all natural systems, social systems and reasoning systems.

Third, based on the policies of implementing S&T developments:

The new policies of S&T developments demand that S&T developments be coordinated with economic and social developments with the enhancement of economic development as the primary goal. This is because modern sciences have increasingly penetrated into all aspects of economic and social life and become an important factor in enhancing economic and social developments. Examples are the identification of economic construction targets, reform of economic structures, rational arrangement of productive forces, reasonable utilization of resources, employment arrangement, population policy, ecological environment, education reform and national defense construction. To meet the needs of coordinated development of S&T, economy and society, it is proposed the science of strategy on economic and social developments be established and advanced. It is hoped that one will, based on the individual's practical need and in addition to the branch of natural sciences the individual specialized in, delve into social sciences such as economics, management science and sociology in order to study and consult by employing a combination of scientific disciplines, to help the decisionmaking organizations implement policies and serve the four modernizations constructions.

2. Study of Macrocosmic Strategic Decision by Closely Combining the Two Major Branches of Sciences

A coastal zone resources survey is obviously macrocosmic, advisory and comprehensive in nature. The content of its study is broad and it studies long-term changes that are not directly detectable intuitively in a short period of time and are hard to control once they become noticeable. Therefore, the overall and comprehensive study of coastal zone resources

development should be approached from a strategic point of view to avoid losses due to blind actions.

To study strategies for economic and social developments requires the concept of viewing the situation as a whole. The development of coastal zone resources is an example. The coastal zone is a transition zone between land and sea and is a territory of special importance. It is located at the outermost front of the coastal area and not only is the door to the interior but is the base and staging area for marching toward the sea. Besides its natural environment and resources, it is the vanguard of national development that is connected with world economic development and is closely linked to the new industrial revolution abroad. Our economy is about to take off. Using the leverage of coastal economic development, the development of the national economy will be enhanced and spurred. With the challenge of the new industrial revolution abroad that is based on computers and marked by ocean development, the role of a modernized economic construction base that the coastal region plays will be increasingly obvious for a large country like ours that is half surrounded by ocean. It is predictable that from now on the coastal areas will attract a large population and the ocean economy era of the 21st century will arrive. This is the starting point and the basis of our studying strategies on economic and social developments of the coastal area. Otherwise, we may make strategic errors.

Area economy is the consequences of the development of socialized large-scale production. It is not predetermined by artificial administrative divisions but rather formed by its geographical features and economic condition. The most important feature is that each economic area has its own advantageous industries and products and most of these areas have concentrations of industries, are progressive, and have ample experience in technology and management. They are well qualified to take hold of world advanced technologies. Currently, an important strategy of our modernization construction is to selectively enhance the construction and development of area economies (economic zones).

Exploratory development is the bridge linking S&T achievements and their applications and is the continuation and development of the coastal zone resources survey. Without linking the survey with exploratory development, the results of the survey cannot be converted into real productivity. Similarly, developmental works not based on the survey and exploratory development will go astray or even ruin resources and waste money.

Because they are parts of the comprehensive study, the close linkage of the coastal zone resources survey and exploratory developments is to be emphasized. In this comprehensive study, the problem of coastal zone resources development and exploitation is studied by using the principles of ecology and economics, the methodologies of systems engineering and the results of each individual discipline. In the process of this study, the resources survey is at the first and second stages of the comprehensive study, the foundation-laying stage. The degree of refinement, precision and science of the coastal zone resources survey have a direct effect on the subject selection and research quality of the comprehensive study and on the reasonable and effective developments of coastal zone resources.

Because exploratory development is a prelude to large-scale development, it is essential to seek quick results, i.e., "do those things that give quick results first, do those that are in a dominant position selectively." Also short-term and long-term benefits ought to be combined. Without short-term benefits, the situation will not be improved. It will not be able to improve the current standard of living of the people, let alone solve big, long-term problems. On the other hand, the short-sighted approach of seeking instant success and quick results will inevitably hurt the overall, long-term benefits.

3. A Few Suggestions on Enhancing the Integration of Two Major Branches of Sciences

To strengthen and advance the alliance of natural and social scientists and to enhance the penetration and exchange between the two major branches of science in order to strengthen the study of strategic decisions on our economic and social developments and to resolve such current and important economic and social issues as energy sources, resources, ecology, environment and population, some problems of understanding urgently need to be solved and forceful measures be adopted to enhance their integration.

1. We should develop those disciplines in which S&T, economics and social sciences have penetrated one another, such as technological economics, information science, future study, management science and scientific sociology. I suggest that these disciplines be included in the curriculum to train people that are well versed in both literature and science for the need of current social development. In the same vein, we ought to encourage natural and social scientists to understand and learn from each other in order to broaden one's knowledge base. Only in so doing are they not limited by their own specialists and able to communicate and think along the same lines.

2. Related organizations and multidisciplinary societies ought to organize natural and social scientists to carry out comprehensive studies on early-phase tasks of key construction items and on important strategic problems related to the national economy and the people's standard of living, to advance the alliance of natural and social scientists, and to provide consultation and suggestions to decisionmaking at all levels of leadership.

3. Aiming at the comprehensive survey of coastal zone resources, I suggest that coastal zone technology development centers be established to enhance the construction and development of coastal cities.

12922
CSO: 4008/343

SUGGESTIONS ON ACCELERATING SCIENCE, TECHNOLOGY DEVELOPMENT

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 5, 12 Apr 84 pp 22-23

[Article by Jin Xiaoyin [6855 1321 6892], Shanghai Silicate Institute, Chinese Academy of Sciences: "Take the Opportunity To Meet Challenges"]

[Text] I. Organize Manpower To Study Countermeasures

Manpower ought to be organized to enthusiastically study the following:

1. When did the waves of the new industrial revolution first appear? Historically, what were the scientific and technological background before and after each industrial revolution? What were the driving forces? What were the major signs? Why is the emergency of a new industrial revolution suggested? What are the major background and signs?

2. Are there leading sciences and centers of their scientific activity? Is the description that "it is concentrated on computers and marked by such burgeoning industries as genetic engineering, new energy sources and new materials" appropriate? Are there different opinions and schools of thought? Who are the main figures and what are the major arguments and their bases of each school? Are different signs and features going to emerge at different countries and areas?

3. How are we going to take this opportunity of the emerging new world industrial revolution to accelerate the construction of a powerful, Chinese-style socialist nation?

All these questions need to be studied with great diligence and I suggest that competent groups from central to local levels be organized to study them.

II. Know the Situation of Our Country and Do Good Planning

When making decisions, particularly on matters of overall importance, the situation of the country ought to be understood first. This is particularly true when studying national strategies. What is the situation of our country? First, we have a population of 1 billion with 800 million being peasants. We cannot forget this fundamental fact no matter what we do. Second, our

science is a drawback and our economy is in a poor state. Development of S&T ought to be based on reality. We cannot overstep the objective reality and rely merely on subjective zeal and imagination. Third, we have abundant labor forces but are short on materials, and financial and energy resources as well as qualified personnel. So we cannot be too involved in long-term, costly and energy-intensive technologies. Rather, those scientific research projects closely related to the national economy and the people's standard of living should be actively assigned in order to benefit the people in a short period of time. For the short term, development and advancement of labor-intensive technologies should be particularly emphasized.

Under the prerequisite of knowing the situation of the country, overall and national planning should be carefully done. In his opening speech at the 12th CPC Congress, Comrade Deng Xiaoping said: "The three major tasks of the eighties for our people are to accelerate socialist modernization constructions, to strive for the unification of the motherland that includes Taiwan, and to oppose hegemonism and maintain world peace." All trades and professions (especially scientists because scientific research is to lead the way for production and construction) should draw up practical, feasible and specific plans that based on the party's and national overall planning and to assure the implementation of them. It is not acceptable to "write plans on paper, talk about determinations but not be able to put one's act together."

III. Reasonable Policies And Steadily Move Forward

1. There must be corresponding independent and steady policies on S&T development.

2. Policies should assure the coordinated development among various departments related to national economy to avoid concentrating on one thing only. Basic research, applied research and developmental research are to be advanced coordinately in proper proportion to avoid attending to one and losing sight of another.

3. Policies should assure the mobilization of the enthusiasm of all kinds of personnel and contain reasonable stipulations regarding the political, financial and cultural treatment of research, technical, management and support personnel as well as party and administrative cadres.

4. Policies should give incentive to the development of frontiers and hinterland to avoid unbalanced development. We have vast territory with the great northwest in need of rapid development. S&T personnel should be encouraged to work and settle in the hinterland. The party Central Committee and the State Council have paid full attention to this matter and it should be followed up with various specific policies.

IV. Set High Standards in Choosing Pioneering Subjects

Science has its own continuity and it is not necessary to start from the beginning. A group of modern research topics, namely the pioneering subjects

within various disciplines that are being studied worldwide and the important, key subjects of our national economy, should be assembled. In other words, we have to have high standard in choosing subjects so that we can work together with scientists in all fields worldwide. We do not have to fool around with topics of the 1940's and 1950's. On the basis of using both internal and external resources, this can be accomplished as long as we actively mobilize experts from all fields.

V. Selectively Import, Digest and Absorb

There are some problems with our current technology-import practices. First, ministries and commissions import independently and blindly and cause redundancy and waste. The redundant import of noncrystalline silicone and optic fiber technologies seems to be emerging. Second, some discontinued products and ordinary technologies have been imported from foreign traders and have resulted in lack of practical use or lack of parts. Third, merely importing and using without digesting and absorbing results in equipment not being fully utilized and our not being able to develop our own product series. As a consequence, we have to import generation after generation. In response to all these, I suggest:

1. The state has to strengthen its leadership role with respect to technology imports. The import of major equipment and assembly lines should be handled by one department rather than independently and blindly done by individual ministries, commissions, provinces and municipalities. The repeated import of assembly lines and major serial equipment ought to be tightly controlled.

2. It should be clear that the purpose of imports is not only to use but, more importantly, to digest and absorb. Namely, "import--digest--absorb." To generate, through imports, new technologies or products of a higher class should become a main guiding principle for import.

VI. Fully Utilize the Results on Hand

After the liberation, important S&T results have been achieved on all fronts each year that should be fully exploited in national economy and defense construction. However, less than a quarter of these results have so far found practical applications and many completed results at laboratory stage have been filed away. The main reasons for these are:

1. Basic research, application research and developmental research have not been coordinated so that many laboratory stage and intermediate stage endeavors end prematurely.

2. Policies on the application and promotion of research results are too vague so that some S&T personnel do not want to work at factories for fear that it would compromise their own research and foreign-language ability while some organizations, due to heavy production responsibility, are unwilling to accept those results that need to be further refined before they can be transformed into productivity.

3. Because there is no perfect system to manage these results, many organizations have duplicated topics and the situation of competing for results often occurs, which results in many organizations reporting their results prematurely and causes difficulties in application and promotion.

I believe that the applicable results, as long as they are currently useful, should be actively promoted before new, better and replaceable results emerge. Through policy, research results donors and recipients should be given incentives. For those results that need large-scale pilot-plant test or assembly-line trial to determine their feasibility, the responsible departments should be empowered with authority to assign appropriate factories under them to set up assembly-line trial with policy guarantees that they will not suffer any financial loss.

12922
CSO: 4008/343

NATIONAL DEVELOPMENTS

ISSUES ON MANAGING SCIENCE, TECHNOLOGY BY LEGAL SYSTEM

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 5, 12 Apr 84 pp 26-27

[Article by Wang He [3769 3109], Jinan University, Guangzhou]

[Text] Who's Entitled to Patent Rights?

According to the patent laws of countries around the world, inventors have the right to apply for and obtain patents. However, many inventions have been accomplished at the state-run scientific research institutes or research institutes of factories and enterprises by the employees of these organizations. Who's entitled to patent rights? The answer differs depending on the specific condition of each case. Inventions by employee can be classified into three categories:

1. Assignment-derived inventions, which are invention derived from work assigned to the employee. In principle, they belong to the organization, which is entitled to patent right.

2. Subordinate inventions, which are inventions obtained by employees while working on assignment or within the business domain of the enterprise and the facilities, equipment and data of the enterprise have been used. In some cases, the organization gets patent rights with a reward to the inventor. In others, the inventor gets patent rights while the organization gets the right to free use. If the invention is the work of many individuals, if it is an assignment-derived coinvention, the organization gets patent rights, whereas the inventors get patent rights if it is not assignment-derived.

3. Free invention, which is invention made by an employee outside the business domain and without help of the enterprise. The organization has no right and inventor should get patent rights.

If the same invention has been claimed by two or more inventors, generally the principle of first application is applied, namely to assign patent rights to the first applicant.

What Is Inventor's Patent Right?

Inventions mean certain significant, new S&T achievements that change current production technologies. It is different from discovery. Scientific discovery means scientific research results that reveal the order of nature. An inventor's patent right is the legal right of the inventor to his own S&T achievements in the form of an invention. This right includes personal rights and property rights. The inventor enjoys the right to a handsome reward. The inventor's patent right is an important personal right protected by law. Since it is inseparable from the person of inventor, by law it cannot be transferred or inherited.

This is de jure recognition and legal protection by the state of the inventor's patent right and preference that inventors are entitled to. If an invention is the work of two or more individuals or collectives, the award of an invention certificate constitutes the legal recognition of their common inventor's patent right and preference. No third parties are allowed to infringe upon the patent right of inventors or coinventors. Also, nobody can apply again for an inventor's patent right on the same invention either domestically or abroad. The invention certificates issued by us have the same legal effect as invention certificates or patent certificates issued by other countries with regard to the recognition of an inventor's patent right and preference. However, because the processings of our patent applications are not announced, not all the contents of our inventions are known abroad and an invention's effect is at times hampered.

What Is the System of Promotion and Utilization of Inventions?

The system of promotion and utilization of inventions means the legal system in which the state regulates, through economic laws and regulations, social relationships resulted from the promotion and utilization of inventions. Ours is a socialist country so inventions belong to the state. It is totally necessary for the state to regulate by legal means the promotion and utilization of scientific and technological inventions. This is not only the exercise of power by the state, as the principal owner of inventions, to provide a sufficient legal basis for their promotion and utilization but also a way of fulfilling the state's economic and cultural functions in a socialist country. The unique feature of this legal system is that the relationship between the state's regulatory agencies responsible for the management of S&T and enterprises that promote and utilize S&T results is defined by administrative order. Legally, it is a leader--subordinate relationship so there is no compensation.

The main tasks of the state to manage by a legal system the promotion and utilization of inventions and S&T results are: to formulate policies on S&T and to guide the promotion and utilization of S&T inventions. Regulatory agencies of S&T ought to give priority to technical evaluations of research and trial-production, to assemble good packages before promotion and to strengthen planning and management during their applications. The promotion and utilization of those inventions that are significant or have wide applications should be included in the national economic plan in order

to provide necessary financial assistance and arrange for necessary preparation projects and raw material supplies and to give tax-deduction and tax-exemption status to new products. The pricing of products should be flexible to help sales and encourage their broader applications.

What Is the Invention Award System?

The invention award system is the legal system that protects and rewards technical inventions. This is different from the natural sciences award legislature. What it intends to protect and reward are not new theories that decipher the subjective rules of nature but rather the practical innovations that solve genuine technical problems. According to the "Invention Award Regulations" revised and reissued by the State Council in 1978, there are three criteria for scientific inventions: (1) innovative, that is, the new products, new processes and new materials claimed by inventors did not exist before and are not publicized or openly used domestically or abroad; (2) advanced, that is, the new inventions should elevate the current technological level of the world; (3) practical, that is, the inventions have practical applications and can be applied to agricultural and industrial production. All three criteria have to be satisfied, otherwise they cannot be legally protected and rewarded by the state.

Invention awards are under the jurisdiction of the State Science and Technology Commission and is either applied for by inventors or recommended by organizations concerned. The following items should be included in the application: 1. title of invention; 2. details of invention; 3. name of inventor(s); 4. reasons why it is an invention; 5. date of invention; 6. date of application; 7. organization recommendations. The application procedure is such that invention application goes through administrative ladders to departments and bureaus of province, municipality and autonomous regions, which then immediately start to process and forward those qualified applications to the scientific and technological commission of their respective province, municipality and autonomous region as well as the department responsible for the work at the State Council. These departments should start the reviewing process promptly and recommend the level of award and submit to the State Science and Technology Commission, which then sets up an invention review committee to recommend the level of award and approve that recommendation. Defense-related inventions should go to the Science and Technology Commission of the Defense Ministry or the Office of Defense Industry for review and award recommendation, which then should be approved by State Science and Technology Commission.

After final approval, the State Science and Technology Commission, based on the principle of moral encouragement supplemented with material reward, assigns one of the four levels to each invention according to its merits and issues invention certificates, medals and award money. The highest award is 10,000 yuan, the second 5,000, the third 2,000 and the fourth 1,000. For collective inventions, the award money should be reasonably distributed among inventors based on their contributions. For an individual invention, the award is given to the individual. Overseas Chinese and foreigners are also eligible to apply. After review and approval, the award will be given according to the regulations.

When there is dispute concerning invention items, it can be solved through either administrative or legal procedures. The party concerned can appeal to higher authority for investigation and settlement. If the personal and property right of the inventor is violated, he can request protection through legal procedures. Suppressing or impairing an invention, making false claims and plagiarizing another's results ought to be corrected through reeducation. For serious offenses, disciplinary actions or even punishments should be applied.

What Is the Technology Improvement Award System?

The technology improvement award system is the legal system that protects and rewards technology improvements. According to the "Technology Improvement Regulations" formulated in 1963 and reimplemented in 1978, technology improvement means technical achievement "that, through research and practical application, enables specific organization to achieve greater, faster, better and more economical results in production or work." It includes improvements of current products, machinery and equipment, technology and methodology as well as improvements of technology, design and computation to efficiently use raw material and energy and take advantage of natural conditions. Although both technology improvement and invention are technical innovations, their degrees of innovation are different. In the former, without changing the essence of a system the innovation is relative while, in the latter, the innovation is very original.

Rewards should be given to those adopted suggestions on technology improvements by either citizens (including resident aliens) or collectives. Rewards may be honorary and material awards, which are divided into five ranks according to the actual value of annual production growth or savings after suggestions have been adopted. Each item of technology improvement shall be awarded only once. And the adoption of a technology improvement suggestion yields a certain personal and property right to the person who made the suggestion. The personal right is that the person is entitled to an honorary award, which means to be commended by one's organization and be issued a certificate of merit. The property right is that the person is entitled to award money according to the rank of the award, of which there are four based on annual economic benefit. The annual economic benefit of 1 million yuan or more is classified as first rank and the award includes a certificate of merit and award money of 1,000 to 2,000 yuan; 100,000 yuan or more is second rank and the award includes a certificate of merit and 500 to 1,000 yuan; 10,000 yuan or more is third rank and the award includes a certificate of merit and 200 to 500 yuan; below 10,000 yuan is fourth rank and the award includes a commendation and award money of no more than 200 yuan. For those technology-improvement or rationalization proposals, such as working condition improvements, production safety assurance and pollution elimination that cannot be directly calculated in terms of economic benefit, the rank of the award should be based on its significance and role. The award money for collectively accomplished items should be reasonably distributed among them based on each individual's contribution.

Awards are reviewed and approved by the recipient organization and reported to higher authority for the record. Award money comes from the recipient organization. Technology improvement or rationalization proposals that are very significant or beyond the scope of the organization should be reported to and handled by higher authority. They are awarded by the recipient organization.

Persons who make proposals are obligated to provide additional information, explanation and any necessary demonstration with the assistance of the recipient organization. The personal and property rights of these individuals are protected by the state and shall be inviolable.

12922
CSO: 4008/343

POLICIES OF RESEARCH INSTITUTES DISCUSSED

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 5, 12 Apr 84 pp 35-37

[Article by Ling Xingfa [0407 5281 4099]: "On Managerial and Project-Selection Policies of Medium and Small Research Institutes"]

[Text] "Five Must" in Managerial Guiding Ideology

1. We must gear toward the needs of economic construction and serve the national economy. For scientific research to be geared toward the needs of economic construction has been the party's and state's policy on S&T development. S&T must be relied on to quadruple the gross agricultural and industrial output value and scientific research institutes themselves can then gain greater vitality and faster progress. This is the soul of a managerial guiding ideology for developmental research institutes.

2. We must foster the idea that S&T must serve production. Medium and small developmental research institutes are established to undertake technology development and to solve technical problems encountered in production processes in the industrial sector. The S&T development of our country is unbalanced. Considerable achievements have been obtained in some very difficult theoretical studies and pioneering technologies but those technologies for large-scale production and with wide distribution are rather backward. To change the situation, medium and small institutes have the following advantageous features: they are widely scattered in large number, they are small and flexible and they are close to industrial production. It is the bounden duty of developmental research institutes to solve the backwardness of production technologies and production problems.

3. We must exploit strength, avoid weakness and take full advantage of one's specialty. This is a common road for research institutes to minimize expenditure, maximize benefits and to grow and prosper. Every institute has its own strength and weakness. Medium and small institutes generally have limited resources and should pay even more attention to exploiting strength and avoiding weakness. Our institute have developed some four-range recording instruments for physiological measurements and gained experience in manufacturing precision parts such as recorder pens. After the 1976 Tangshan earthquake, departments concerned planned to build a network of earthquake monitoring and forecasting stations. One of the

key pieces of equipment--a six-range terminal recorder for long-time monitoring, needed to be fabricated. They visited numerous large organizations. But some were unwilling and others unable to accept the order. Our institute, because of our experience in developing the four-range recording instruments for physiological measurements and our specialty in instrument development and production, was able to accomplish, through overcoming difficulties, this research assignment and was awarded at the 1978 National Science and Technology Conference. Over 100 recorders have been maufactured since then and the urgent need of the country has been met and our institute has increased output value by over 2 million yuan. By exploiting strength and avoiding weakness, it can be said that we have killed three birds with one stone.

4. We must serve customers wholeheartedly. To be successful in business and win the trust of customers, this is a must. Japanese respectfully regard the customer as "king" and we have an old saying that describes customer as "parents who provide us with food and cloth." These are wise summaries from practical experience. Based on our national economic system, which is mainly planned but supplemented with regulation, and under the situation that the scientific research market is gradually changing from a seller's to a buyer's market, we have more reasons to do so. To serve customers, we cannot behave like capitalists whose only interest is making money. Money only partially reflects the economic benefits of organizations. Our relationship with customers is a brotherly, cooperative one between socialist enterprises and institutions to strive together for the four modernizations. We should not be worried that customers have high standards for quality and want things fast, not criticize customers for constantly changing their minds and being demanding. We must look at things from the customer's point of view, not only knowing what they want but knowing what they overlook. Customers tend to change their mind and are not able to give clear specifications initially. It is unavoidable that some things get left out. Since we are more familiar with similar projects, we have the responsibility, capability and opportunity to help customers with something they have overlooked. Only in so doing can we win the heart of a customer. For example, when we were discussing a remote-sensing environmental sanitation engineering project with Nanjing's Environmental Sanitation Department, we told them about the experience of another place, reminded them of what they had overlooked and made suggestions. They were very satisfied. Furthermore, for those that have technical potential, are not costly and are reasonable in economic benefits, we should take the initiative to raise the quality index. And for those that can improve product functions and reliability and those demands that are beneficial to operation and maintenance and that are technically feasible, we should try our best.

After completing a project, follow-up is also necessary. Products we have developed are for use or expanded production. Only if we accomplish all these can customers not refrain from doing free propaganda and "super advertisement" for us, which will spread the institute's fame and increase the institute's business.

5. We must adhere to the direction of focusing on scientific research to produce results and talents. The workload of research institutes is heavy

and diversified. Just a slight oversight often leads to the situation of attending to one and losing sight of another. Emphasizing results while relaxing talent training in intelligence-investment strategy or being satisfied with trial-production of research results and doing small-volume production that interferes with scientific research are all deviations from the center and not acceptable.

"Seven Depend" in the Conditions of Project Selection Policy

For institutes to benefit our country and people and to grow and flourish, project selection is very important. It is one of the keys that can make or break an institute. To make good project-selection policy depends on seven aspects.

1. It depends on whether they are urgently needed for national construction. It is not appropriate to undertake marginal projects when national financial and technical resources face difficulties in order to avoid spending the limited resources on the wrong place. We should study diligently those problems in national construction or production that urgently need to be solved.

2. It depends on whether projects are within the specialty and technical expertise of the institute. Institutes generally have obvious areas of specialization and have acquired technical expertise through carrying out scientific research. To undertake projects that are within the area of specialization means they can be done with high proficiency and that skills will be constantly improved and become increasingly mature to eventually get twice the result with half the effort. Otherwise, it would be hard to figure out where to begin and to start from scratch will interfere with the established specialty and get half the result with twice the effort or even waste money and manpower and accomplish nothing.

3. It depends on whether projects involve advanced technology and whether there are developmental potentials. Scientific research projects are creative tasks of exploring the unknown, the purposes of which are to obtain advanced technologies, equipment and materials and to find their applications. In the past, projects were often selected because of inadequate investigations, unreliable information, the desire to get quick results and immediate benefits, personal interest, force of habit and a senior official's will. They were rushed with sudden inspiration and ended disastrously. For example, with the development of tourism, there has been a boom in guesthouse construction. The problem of automatic door technology needs to be solved. A certain automation institute, after careful study, decided that the step-on contact opener was out of fashion and the radar type was too difficult, so the infrared sensing opener project was adopted. With substantial efforts, it was finally completed. Then, it was discovered that it was not suitable for all-weather operation. In cold winters with gusty winds, the human body is pretty cold and cannot emit infrared radiation so the door will not open. In fact, the infrared sensing door fell into disuse abroad in the late 1960's. But another institute, by employing advanced technologies, has developed the radar automatic door. It is advanced technically with

a future for development. It is becoming very popular and is receiving many orders and production arrangements.

4. It depends on whether the instruments, equipment, materials and talents required for projects are available or realistically attainable. We have to have both revolutionary enthusiasm to contribute to our nation's four modernizations and a scientific attitude of seeking truth from facts. We must avoid the left-wing approach of wasting money and manpower with no regard to reality and economic benefit like the "qualified or not, have a piece of the action" phenomenon during the 10-year internal turmoil. We get some lessons from this. For example, we noticed that our country urgently needed a full power frequency synthesizer, which also coincided with the development direction of the institute. We though we could rely on importing such key elements as large-scale integrated circuits to carry out developmental work. More than 20 scientists and technicians were assembled and divided to tackle different problems, which almost consumed the resources of the entire institute. Eventually, the large-scale integrated circuits import did not go through and test instruments could not meet the demands. The whole thing was called off. Therefore, project selection should be based on the situation of the country and of the institute.

5. It depends on economic benefit. The old-fashioned way of ignoring economic benefit has caused big losses in our national economic construction. At present, our country has financial difficulties and a shortage of funds. Therefore, all trades and professions must increase production and cut down expenditure to raise economic benefits. To spend time on projects with no economic benefits is like a poor surgeon performing a surgical operation. The operation is done but the health of the patient is not improved. Thus, projects that need little investment, will yield quick results and can be easily applied should be selected. In particular, attention should be paid to select projects similar to those that have already yielded some results or are currently being studied. Thus, one can comprehend by analogy and draw inferences about other cases from one instance. Also, investment in instruments and equipment can be reduced and technology transfer, technology inheritance, speed-up of study and technical resources conservation can be accomplished. For example, after the Shanghai S&T achievements exchange meeting held in spring of 1982, customers have suggested many research projects. Digitally transmitted communication has been proposed by the Public Utilities Bureau, Shipping Bureau and others. Under the circumstances, one must act according to one's capability and choose and follow what is good. We have developed a digital transmittal weather station. The Public Utilities Bureau wanted remote sensing of gasline pressure and a remote control center, whereas the Shipping Bureau wanted remote control and a guiding system for ships. After investigation and study, it became clear that Public Utilities Bureau's requirements were closer to the Weather Bureau's digital transmittal station, were superior in research conditions and were higher in economic benefit and whose needs were more urgent. So we selected the Public Utilities Bureau's project. It was finished in the same year and reaped benefits.

6. It depends on whether projects are overlapped with those of the sister organizations within one's field, one's local area and the country. Some

institutes have shown ignorance of economic benefits and disregard for the arrangement of national planning and often follow the trend, go for the hot items and swarm to places where the state has made large investment. These lead to fighting for investment money, eating from the same pot and duplicating effort. As a result, they all waver at a low level and pull each other's leg. This kind of practice is bad for the nation, for the people and for the institute.

7. It depends on whether there is successful experience abroad and whether samples and prototypes can be imported. There is a gap between the S&T level of medium and small institutes and that of the advanced. For projects that have not been successfully accomplished, medium and small institutes generally should not overcommit themselves (with the exception of those with higher qualifications). Instead, emphasis should be on technology import. It is particularly important for technically weaker medium and small institutes to start by imitation then innovate or innovate while imitating. The imported samples and prototypes should be disassembled and analyzed, essence be selected and dross discarded to improve them and make them serve our needs. This is a shortcut to success.

12922
CSO: 4008/343

NATIONAL DEVELOPMENTS

IMPORTING BRAINPOWER VIEWED FROM ANGLE OF ECONOMIC DEVELOPMENT

Tianjin KEXUEXUE YU KEXUE JISHU GUANGLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHOLOGY] in Chinese No 11, 12 Nov 84 pp 23-26

[Article by Shen Xiaodan [3088 2556 0030], China Scientific and Technical Association; edited by Huo Hua [3499 5478]: "A Study of China's Policy of Importing Brainpower Viewed From the Angle of Economic Development"]

[Text] The most precious of the forces of production is human resources. In the final analysis, the opening up and utilization of natural resources, society, culture and the creation of wealth are all due to the labor capabilities of human resources. As Marx put it: "By labor-power or capacity for labor is to be understood the aggregate of those mental and physical capabilities existing in a human being, which he exercises whenever he produces a use-value of any description." ("Ziben lun" [Das Kapital], p 190.) A result of the Eighteenth Century industrial revolution was to "prolong" and "amplify" human physical strength. However, this happened through a profound change in one bodily function, i.e., in the power of human intelligence. Thus, in modern society, people differentiate manpower resources as being simple labor which relies chiefly on physical strength and complex labor which relys chiefly on brainpower. From this, the development of intelligence is the fundamental connotation of the development of manpower, in its intrinsic nature characterized by the human cerebrum reproduced as a labor tool. Daily, history has brought mankind to the understanding that: in the contention for manpower, careful attention to intellectual development has become an important frontline measure in the advancement of society and economic development.

This is the reason why developed nations use favorable pay and excellent working conditions to attract manpower from abroad, and this has become an important contemporary means of exploiting developing countries and regions. Statistics show that every year developing countries lose as much as U.S.$5 billion because of this outward flow of experts.[1] In the period 1961-1972, the United States, Great Britain and Canada provided aid to developing nations that totalled U.S.$46 billion; but during the same period, they were absorbing manpower from the developing nations to the extent that these three nations gained manpower capital valued at U.S.$51 billion.[2] It is obvious that an important question of manpower economics is how are developing nations and regions to import advanced brainpower from the developed regions and at the same time advance the

intellectual development of their own areas. This is a key policy question for the undeveloped regions. The writer will attempt here an analysis of the problems of China's importation of brainpower and manpower, reflecting on this from the angle of economic development, and examining the suitability of this fundamental policy of importing brainpower for developing nations.

Chief Problems of China's Importation of Manpower

"Importation of manpower" is a means of importing intelligence by using people as the principle carriers of S&T results. Obviously, the intrinsic character of intellectual development determines that the importation of manpower is the most direct and fundamental means of intellectual development. This approach generally includes the two forms, "send out, invite in." One form brings in S&T personnel from advanced nations and regions for a reasonably long term to impart knowledge and technology in the local area; the second is to send S&T personnel from the local area to advanced countries for study, after which the personnel return home to put their knowledge to use. According to statistics, of the several tens of thousands of S&T personnel China has sent abroad for study during the past several years, nearly 10,000 have returned to this country. There have also been several hundred experts either foreign or of Chinese descent who have been attracted here by favorable remuneration and conditions. This group is generally at the international level of advancement of their professions, and are the absolutely valuable scholarly leaders in our S&T development. Fully bringing into play the potential of this group of manpower resource will have a bearing on improving the level and organizational practice of China's entire S&T team.

But surveys also indicate that: with the exception of a very few reputable individuals from this batch of manpower who could be brought into full use owing to their having received special attention while out of China, generally the situation has been that they still cannot come into full use. Also, their work results are still far from those abroad, and not even up to what the situation was originally in China. A female Ph.D., in a statement published in various newspapers, appraised her work after returning to China as: $(7 \times \frac{1}{2}) < 1$, meaning that during a week in China, she would spend but half of her work time at her professional work, and the total of this was still not up to 1 day spent abroad!

What are the reasons for these widespread problems? Further surveys and research have suggested the following four primary factors:

(1) Working Conditions Which are Lacking in Essential Equipment, Interchange of Materials, etc.

S&T personnel who have returned from abroad have pointed out that a direct reason why the level of S&T is higher there is that their instruments and equipment are advanced, materials information exchange is timely, and logistics services are well-managed. Add to this the effective and widespread use of electronic computers, and they have the optimum working conditions. Therefore, the greatest barriers to returned personnel coming into full

use after they have returned to China have become inferior working conditions and low management level.

(2) The Special Fields They Studied Abroad are not What China Needs for S&T Development

Going to capitalist nations for advanced study is, in essence, "selling high-ranking labor cheaply." But it is sending the nation's hope that for this price we can bring back the expert knowledge, the science and technology needed for our socio-economic development. However, when the weak are studying the strong, it is difficult to be choosy and stand on one's own feet; add to this the developed nations' use of "financial aid conditions," "degree requirements," and "knowledge-seeking psychology," to attract S&T talent from various nations to join for extended periods of time the scholarly fields which the developed nations require. Moreover, the developed nations have been known to push aside, exporting in an "outflow" those S&T personnel for which their socio-economic development has little need. This sort of manpower strategy causes the talent China sends abroad or the experts she imports for the most part to adjust to a lower base of socio-economic benefits and to applied research areas. This deepens still further the contradictions between importing talent and practical working conditions.

(3) The Imbalance Between Local S&T Personnel's Specialties and Administrative Levels and Organizations

The departmental system of ownership in China's system of S&T personnel management, on top of the bureaucratic way of doing things, makes it difficult to maximize the superiority of the management plan for talent allocation. There has not been a complete, long-range study of going abroad for study; the practice of importing experts, either foreign or of Chinese descent, has not been examined from the standpoint of local and national S&T needs, nor its compatibility with economic developmental needs. Therefore, it is difficult to organize outstanding imported talent into echelons, to arrange for them to have appropriate assistants, and fully bring into play their "igniting" function. This makes it easy to give too much attention in importing talent to spending excessive amounts of money on remuneration arrangements or on bestowing large awards which are undeserved, which necessarily leads to the contradiction of there being different channels of communications between imported talent and local S&T personnel.

(4) Various Kinds of Remuneration and Society's Worries and Pressures Regardless of whether they are students who have returned from study abroad or are imported experts of Chinese descent, their opinion is unanimous that: the S&T scholarly community abroad has been able to smash egalitarianism because they know their personnel well enough to assign them to commensurate jobs, they know their talents and abilities, and encourage people to "stand out." This is an important societal condition if S&T and the economy are to develop more rapidly. But in China, "eating out of the same pot" not only leads to a low rate of work efficiency, but also produces assignment by seniority, a breeding ground of resentment and jealousy.

For this reason, these comrades feel, if they abandon the excellent pay and conditions offered abroad because of their enthusiastic concern for the "four modernizations" drive, not only will they see many strange phenomena and inequitable treatment in wages and other remuneration, but many will also encounter much gossiping reproach and unreasonable restrictions at work. As a result their spirit of dedication to their work and devotion to their country will have cold water dashed on it.

From these problems, we can formulate a principle: the importation of manpower and its full application cannot depend upon patching together a few policies, and also cannot merely place its hopes in the "bo le [0130 2867]" opportunities and enlightened leadership of one or a very few individuals. For just a Comrade Deng Xiaoping has profoundly noted, "The mistakes that we have made in the past are doubtless related to the thinking and ways of doing things of some leading persons, but are even more important questions for the organizational and work systems...If we do not resolutely reform the corrupt practices in the present system, then some pressing problems that arose in the past will possibly emerge anew in the future." "Deng Xiaoping We Xuan" [Selected Writings of Deng Xiaoping], p 293. This observation has, in the same way, important leading significance for the system of importing talent. In reforming the traditional system, the most important thing is to have the policy's overall plan established on a foundation of science. I know that this will carry out the overall strategy of coordinated development of S&T and the economy.

On the Stages of Opening up the Intellect and Developing Economic Coordination

Development of S&T and economic coordination is a general law of developing the system of the forces of production. However, dissimilar nations and regions give expression to this law in importing talent and opening up intellectual development, the vital problem is to objectively evaluate the needs of intellectual development in the different stages of development of the forces of production, and moreover, based on these characteristics decide on the basic policy for importing intelligence. In this regard, and based on what he knows of economic science's development, the author will attempt to set out the three stages of intellectual development (in order):

(1) Completely Opening up and the Initial Stage of Importing Intelligence

This is basically a stage in the development of society. Because the S&T level is very low during our modernization, production relies chiefly upon a large labor force, the greatest proportion of which is the agricultural labor force. The residential consumption level is low, carrying out a management system that cuts across economic levels and the family's trandi-tional veiwpoint, with an important function in the mentality of society.

Therefore, in this period the object of intellectual development is to raise the scientific and cultural level. The chief significance of importing intelligence in government, culture, etc., is it cuts across economic needs, and moreover is influenced by the traditions of society and by cultural habits.

During this time the carrier of imported intelligence is for the most part dependent upon S&T books, journals, various kinds of documentary materials, etc.

(2) Selective Opening up and the Middle Stage of Importing Intelligence

This period basically belongs to the societal stage of economic takeoff. During this period, there should be on the one hand a breakthrough in the "aging," traditional way of looking at things; on the other hand, there needs to be a resolution of the basic situation of economic activities: the agricultural forces of production develop by leaps and bounds, application of modernized equipment is widespread, and there is a considerable accumulation of funds. The economic substance of this process is in the passage from a labor force (physical) concentration to a funding and equipment concentration, with the result that modernized technology and management have become the key to the economic takeoff.

During this period, the chief responsibility of intellectual development is to advance the development of the economy. The chief significance of the importation of intelligence is to promote economic benefits and bring to the fullest the superior industrial organizations located throughout the nation. At the same time, enterprises are subject to existing restrictions on funding, equipment and technological reform. The result is that a fundamental characteristic of intellectual development in this period is the emergence of products as the carrier of imported intelligence. Intellectual importation and its application being brought into full use has a particularly close relationship to the modernization of plants, communications, instrumentation and equipment, research, etc.

(3) Creative Development and the Highest Stage of Importing Intelligence

The departments which are involved with the national economy during this stage are already basically equipped to carry out modernization, production and income are going up continuously, and society's consumption has reached the modernization level. People's overall needs and continuous development both require increased equipment funding, the expanded application of existing S&T results, and there is a switch to giving attention to creative labor thought.

Therefore, intellectual development in this period is mainly characterized by S&T breakthroughs, and the primary objectives of importing intelligence are scientific creativity and management innovation, and by bringing the forces of production to a new level of taking off through developing industrial organizations and society's labor organizations. Therefore, this period's chief carriers of imported intelligence are individual trades which are at the modern S&T level, and moreover can carry out creative labor's talents.

The summary related above concerns different nations and regions that have gone through the several economic--S&T development stages at different times, along with the varying speeds at which they went through the course of development. (This is related to the S&T and economic position they

held in the world at the time). People have held up the United States, Great Britain, Japan, etc., as differing S&T development models; these models should be regarded as a cross section of comparative descriptions in differing regions in certain historical periods. Clearly, nations or regions which do not possess the basic level of science and culture for that time are those which cannot choose and receive advanced S&T results; and, the lack of modern technological equipment and research prerequisites can be fatal to progress in developing areas of research. Therefore, the stages described above can reflect the regulative connection between the results of intellectual development and the adjustment of socio-economic development by S&T.

For this reason, in China's present status as a developing nation not yet in possession of "creative conditions for an economic takeoff," to emphasize "a spectacular great nation," or talk in general terms of the "need to increase both basic research and the application of technology," is a viewpoint which is not beneficial to implementing the general S&T development policy of "developing coordination between science, technology, the economy and society," and will result in the loss of manpower development, utilization arrangements and the stages of economic development.

On one hand, there is a surplus in our research and technological force, with a shortage of equipment and conditions, resulting in serious waste. From the following table's[1] comparative analysis can be seen the degree of macroscopic imbalance in how China's S&T personnel activities are arranged.

But on the other hand, the technological development of our S&T strength is weak. Of the S&T personnel who have gone abroad in recent years for advanced study or to attend school, 70 to 80 percent have chosen basic or applied subjects to major in, making it difficult to raise the professional level of S&T personnel engaged in production technology and developmental research. According to statistics from the end of 1982, there is an obvious regional variation among S&T personnel teams, and when these striking analytical statistics are arranged in a table, some problems can be explained.

Study China's Current Basic Policy on Importing Intelligence

China's present work of importing intelligence mainly follows three patterns: the first is the importation of S&T knowledge by means of informational materials, some 100,000 documents annually; the second is by means of international conferences, participation in interviews, which annually permits several tens of thousands of China's S&T personnel to acquire directly the very latest in S&T thought; the third is through such activities as overseas study and research or long-term lecturing, allowing several thousand members of our S&T community annually to systematically study the newest international science and technology. Obviously, these activities all have an important function in China's importation of intelligence. However, to suit the needs of China's "four modernizations," it is essential that we move forward in raising the economic of intellectual development. At present, both Chinese and foreign experts appraise the situation as follows: in China's natural science, the fundamental theoretical research level,

Table 1

Country	Japan	USSR	U.S.	China				
Time Period	1975	1976	1975	1978	1979	1980	1981	1982
Total S&T Personnel (in 10K)	2053	2280	1320	434.5	470.5	527.6	571.4	626.4
Total Research Personnel (in 10K)	49	125	59	31.0	31.7	32.3	33.8	37.2
Proportion of Personnel Engaged in Research (%)	2.4	5.5	4.5	7.1	6.7	6.1	5.9	5.9

(1) References: "Shijie Jingji Nianjian" [World Economic Yearbook], p 865;

"Zhongguo Tongji Nianjian" (1983) [China Statistical Yearbook (1983)], p 525;

China Academy of Social Sciences. Information Section. WEILAI YUCEXUE YIWENJI [TRANSLATED ARTICLES ON FORECASTING], p 148;

SSTC Policy Research Office. NEIBU TAOLUN (No 421) [INTERNAL DISCUSSIONS (No 421)], 4 Feb 1983.

Table 2

Percentage of Personnel in Each of Three Grades

Locality Type	Top Grade	Medium Grade	Initial Grade	Ratio (High-Medium-Low)
Central Govt. Units	2.19	35.44	62.37	1 : 16 : 28
Beijing, Tianjin, Shanghai Units	1.08	18.98	79.44	1 : 17 : 74
Units Under 26 Other Provinces and Localities	0.42	10.84	88.74	1 : 25 : 209

published papers and teaching materials are, in general, not inferior to those of Japan, the United States, Western European nations, etc. The weak spot is the level of economic management and the need for advanced equipment and sophisticated methods in activities which would develop science and technology. From this it becomes clear that Chinese intellectual development has completed the first stage and has just entered the second stage, while the work of the third stage in general has not yet received full attention nor been brought into full play. Therefore, we should adopt the following fundamental policy: step up the exchange of information and knowledge; try our utmost to have imported intelligence brought in with the products we purchase; combine the importation of talent, projects and the purchase of equipment; implement economic construction through topics, with talent and equipment importation under a unified management for intellectual development and usage policy.

What is new in the policy proposed above is this: the use of material goods as the carrier for importing knowledge unites the purchase equipment with the "importation" of talent. Doing this will have a deep and far-reaching significance on China's S&T and economic development and production, several effects of which are given below:

(1) An increase in the substantive relationship between S&T and economic development. Assistance to the technological development of enterprises and giving favored treatment to the talented, according to the principle of allocation of labor, advances the overall reform of enterprises.

(2) Overcome dispersal, duplication, waste and difficult conditions in research work, abuses which make it difficult to unify planned management. Accelerate the establishment of industrial-research centers to avoid the inequitable use of manpower, to achieve the overall coordination of those areas where S&T are related to economics, and bring into full play the greatest efficiency of people and materials.

(3) Unify equipment importation and carry out training and tackling of key problems from such aspects as design, application, maintenance, theory, etc. This will make it possible to form top-notch personnel (including those invited in and those sent out) into the nucleus of teams. Moreover, it will speed up such interrelated subjects as the intellectual development of professions, and achieving the copying of equipment, leading to our catching up and overtaking, digestion of technology and new ideas, theoretical studies and standing out.

(4) In order to avoid relying solely on pay or patriotism to attract talent from overseas, use currently existing starting enterprises to summon S&T personnel. This would be appropriate to the special characteristics of modern society's manpower psychology, and also embodies the frontline characteristics and latent superiority of the developing economies of the developing nations.

12625
CSO: 4008/223

CONTRACT RESPONSIBILITY, S&T CADRE MANAGEMENT REFORM DISCUSSED

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 11, 12 Nov 84 pp 27-29

[Article by Tan Gexin [6223 7041 2946], Tianjin Science and Technology Commission; edited by Huo Hua [3499 5478]: "My Humble Opinion on the Technology Contract Responsibility System and Reform of S&T Cadre Management"]

[Text] The technology contract responsibility system is a measure for reforming the system of S&T management and S&T cadre management. In order to set up and put into practice the technological contract responsibility system for support of industrial production and technological work having dissimilar characteristics, it is necessary to adjust and perfect the economic policies related to technological cadres and S&T, and it is essential to reform the S&T cadre management system. The purpose of this article is to explore further certain problems related to the establishment and implemention of the technological contract responsibility system and reform of the S&T cadre management system, and by means of this draw them to the attention of S&T cadre managers and a wider audience of S&T personnel.

I. To Perfect the Technological Contract Responsibility System, it is Essential That we be Flexible in our Employment of Talent, Management of Technology and Handling of Economic Work at All Levels.

Some say that in the technological contract responsibility system, the emphasis should be on that part of the word for "contract" which means by itself "undertake." I realize that this way of wording it is still subject to discussion. I know that by taking the small producer's mentality and traditional viewpoint to understand and recognize the essentials of the technological contract responsibility system, we can conclude that it is completely wrong. When we implement the contract responsibility system, we absolutely do not advocate that individual or a few S&T personnel "go it alone;" and, by being flexible in our handling of talent, technology and the economy, by transferring personnel positively, we can make maximum use of S&T progress in economic construction and raise economic benefits. I am certain that in carrying out the technological contract responsibility system, we must make "flexibility" the watchword, at all levels of labor in employment of talent, management of technology and handling of the economy.

In implementing this system, the first step is to be flexible in handling employment of S&T personnel. In order to accomplish an economic construction mission, selecting what kind of S&T economic benefits are really the best, S&T personnel can propose many different kinds of plans. In the technological contract responsibility system, not only can the local unit's S&T personnel enter a bid, but S&T personnel from outside units can also propose plans and seek consulting jobs. They can participate in discussion of the plans, and campaign for jobs, with the contract going to the one with the best benefits. Obviously, flexible employment of talent is of the highest priority.

How can we be flexible in our employment of talent? I believe there should be a bold reform of the system of managing S&T cadres. At present, China's existing system of S&T cadre management still follows the system formulated just after liberation for managing the old economic system. Management leaders in S&T and the economy had no power to transfer, assess, promote, reward or punish S&T cadres. Also, the departments which managed S&T cadres did not understand the needs of S&T and economic development, creating a management of talent microcosm that was seriously out of line in employment and management of talent. In the management of talent macrocosm, the directed plans were too disruptive, with too many "arbitrary uniformity" policies, with the result that units lacked the self-governing power to hire and fire S&T personnel, and the personnel would lack the power to choose their work stations. This kind of system of S&T cadre management led to "the talented units have and departments have." Because this situation became daily more serious, it further led to S&T work being arranged administratively and directed the assignment of S&T project responsible persons to a "tenure system," creating a situation where administrative management is substituted for technology management. If we seek flexibility in our handling of technology management, at the higher levels S&T management departments must combine the management of S&T talent with the management of S&T in several areas, beginning to assume the heavy responsibility of merging management of S&T and S&T talent into an organic whole. At the middle levels, S&T departments should also set up S&T cadre management organizations, forming the management of S&T and S&T into an organic whole system. At the lower levels, we should put into effect a factory director, school director and institute director system, whereby such matters as the transfer, assessment, promotion and rewarding or punishment of S&T cadres will be managed by the chief administrative leaders and the leaders responsibile for S&T work.

In addition, in S&T cadre management leading thought, there should be another bold reform. As part of a technological contract responsibility system, it should be required that in policy which concerns assessing, promoting, rewarding and penalizing S&T personnel, the strategic policy of "science and technology must be geared to the economy, economic construction must rely on science and technology" must be obeyed and served. In enhancing economic benefits, and promoting the progress of S&T, S&T personnel who have made contributions should be given precedence, skipping a grade in promotion, and given wage increases. This revises the old type of one-sided management which stressed academic achievements without regard to contributions, emphasizing such things as foreign languages and theoretical

levels while ignoring actual capabilities. Following the law of S&T development, the law of value and the characteristics of S&T work, we must adhere to managing S&T cadres by the principle of uniting S&T management with management of S&T talent.

2. The Multiple Goals of the Technological Contract Responsibility System and the Multiple Goals of Policies on S&T, S&T Cadres, and the Economy.

The technological contract responsibility system is organized on many levels. At the highest level there is the responsibility and authority of technology leaders to assess goals and make rewards and punishments regarding them. At the next, it is the responsibility and authority of those responsible for projects, those partly responsible for projects, and in general those who participate in projects to assess goals and levy rewards and punishments regarding those goals. This constitutes the overall assessment of goals and overall objectives. If one examines the different levels of the technological contract responsibility system, one sees that there are different types of assessment goals. In general, these can be divided into technological goals, economic goals, time goals, efficiency goals, coordination goals, societal and environmental goals, and many others. The determination and assessment of these goals are directly related to the problems of certain specific policies currently in effect. If the application of advanced technology greatly depletes raw materials and energy resources, but in doing so increases economic benefits, then economic goals are easily planned and evaluated. However, if application only raises the quality of products, improves product performance or extends a product's technological work lifetime, then it becomes quite difficult to assess economic goals. We still lack a set of specific, scientific, high quality, high value policy provisions. For another, the S&T cadre management policy also continues the problem of progressively establishing and expanding several dissimilar models of technological contract responsibility systems. The policy on assessment and promotion of technological titles, while far from emphasizing academic achievements, foreign languages and the theoretical level of professional work, still pays insufficient attention to the actual economic benefits of technological work and contributions to society. This contradicts the weighted assessment of the essential goals of the technological contract responsibility system, and is very disadvantageous to the setting up and implementation of such a system. Regarding S&T policy, there are also a great many problems which merit study. One such problem is that of an enterprise which chooses a new technology requiring the expenditure of a considerable amount of funds, so it requests a one-time loan of several million yuan. A major problem then becomes how to subsidize the enterprise in replacing their technology, and impel them to apply that technology as soon as possible in order to enhance their economic benefits, and so pay off their debts. This is a major problem. Some enterprises, due to the continuance of some irrationalities in our S&T policies, slow down the pace of technology replacement.

These problems demonstrate that under our present policy of S&T cadre management, S&T policy and certain economic policies are often regarded as merely an aspect of developmental needs, which ignores the needs of

certain related aspects. They are appropriate only to the objectives of one aspect of the system, lacking the characteristics of multiple objectives. The chief reason for this is that the departments formulating policy have often merely considered the needs of their own work, and have not systematically considered what is required by other aspects of the system's management policy. Modern S&T development and modern economic development both urgently require that we achieve management of the economy, society, S&T and manpower as an organic whole. The technological contract responsibility system also requires that there be a comprehensive assessment of the goals of all aspects of S&T, the economy, society, etc. This in turn demands the adjustment of the various management policies currently in effect, and the careful consideration of fundamental adjustments in various topics concerned with objectives. S&T cadre management policy still must be considered with the needs of S&T and economic developmental objectives, subordinate to and serving the needs of S&T progress and the new programs of S&T development. Economic policy should also take into consideration the growth to maturity of S&T manpower, what is needed to attain the objective of development of S&T contingents, and consider the needs of S&T development objectives. S&T policy must also consider the maturation of S&T manpower and economic development objectives. In setting up and perfecting a technological contract responsibility system, further adjustment of the various policy objectives is absolutely essential.

3. The Organization of the Technological Contract Responsibility System and the System of Appointing S&T Personnel.

While conducting a survey dealing with livelihood and wage issues among younger scientists, technical specialists and managers who had made notable contributions, we found a great many of these worthy people raised this sort of very bitter point: S&T positions are allocated by a system of choosing leaders, not by a system whereby choices are made based on bids and S&T personnel's abilities. In the present system, some personnel have "good luck" and can make notable contributions, while many worthy and talented S&T personnel do not have this "good luck," but are held back and stifled. Many S&T personnel urgently demand a change in this situation.

How can we change this irrational mission allocation system?

It is my conviction that the implementation of a technological contract responsibility system will not in itself completely solve this problem. There should also be instituted at the same time an appointment system for S&T personnel.

Putting into effect a technological contract responsibility system will smash the "common pot" and "iron rice bowl" in S&T personnel payment; in addition, it will smash these evils in the area of assigning work missions, really furnishing S&T personnel of ability an abviously bright opportunity. Evidently, in choosing this way in which to implement the technological contract responsibility system, it would be unacceptable to leave the S&T personnel management system unchanged.

At present, within units there should be implemented first of all a system for inviting bids from persons responsible for S&T missions and a system to appoint and nominate persons by the people responsible for projects. In the past, it was often the case that persons responsible for projects were led and directed by administrators. This often resulted in a tenure system for those responsible for projects and a lack of caring whether a project was done well or badly. When a technological contract responsibility system is implemented, there should be a method included which defines the project mission, clearly assesses its direction, and permits S&T personnel to bid competitively for projects. In this way, the best people can be selected, and not only can a large number of S&T personnel be transferred positively, and S&T missions splendidly accomplished, but there will be clear and bright conditions created for ambitious and talented young S&T personnel. In practice this should produce a batch of top-notch S&T talent. As for the organization of project personnel, there should be for the persons responsible for projects freedom to nominate and appoint people. They most clearly need specialists; what they need least are several people. Choosing the project responsible person to nominate and appoint people, those S&T personnel in supporting roles will be easily and completely convinced, a much superior system to administrative allocation. People are often worried that there will be a surplus of S&T personnel, unwanted by anyone, and how can a place be found for these? As a matter of fact, it is very simple: new projects can be started up; they can be released from regular duties for advanced studies and upgrading; or, they can enter mobile status and transfer to other, more appropriate work stations or units.

Among the units, there should be implemented a system for appointments to positions. Based upon mission requirements publish a roll recruiting the able, sign contracts for temporary appointments, and let them find their own way during the appointment period. People often worry that selection of this method will cause their own technical tricks of the trade to be uncovered by other units; I do not think this is likely. The situation would be similar to that in the United States and Western Europe, where many businesses have implemented this kind of system. They prevent this by their treatment of those people who control the business's tricks of the trade, supplying them with excellent wages and benefits in their living conditions, and by improving their working conditions; this fosters a spirit of trust. They use methods of encouragement, rather than intimidation, to bind S&T talent to their own units. Moreover, due to patent law practice, there are legal guarantees on this question. The implementation of an appointment system will be of benefit in discovering new talent, and encourage S&T personnel to study new findings of their fields; it will be beneficial to the exchange of learning and technology among S&T personnel, and raise the level of S&T in China. The implementation of this kind of system will assure that S&T personnel do not fall into the "rice bowl." If someone does fall, it would be an extremely small number of people, the idlers and the incompetent. At present, an appointment system is being advocated strongly by academic institutions, scientific research units and industrial enterprises. Implementing the appointment system, there should be bid tenders, assignments and transfers by plant heads, heads of academic institutions, heads of institutes and leading responsible S&T persons in charge

of S&T work, changing the present disjointed way of employing and managing personnel.

In addition, we should also push for S&T personnel to hold concurrent posts, especially after-hours part-time jobs. At present, some institute and plant heads fear this greatly, for they worry that S&T personnel will not do their work to the utmost during the day, so that they will have something left for their after-hours job and the extra income it brings. As I see it, if a technological contract system were in effect, there should be no worry about these people. If they cannot complete their work, they can be penalized, dismissed or replaced with someone better qualified. The initiative is entirely in the hands of the unit. Spare-time employment should be recommended for the following reasons: first, China is severely lacking in S&T talent, especially at the higher grades; many businesses and units have a severe lack of S&T personnel, and if these personnel are prevented from taking spare-time, concurrent positions there will be no way of satisfying the needs of our businesses and units. Second, spare-time jobs can expand S&T personnel's field of vision, and can also be of benefit in raising the overall level of S&T, by advancing the competitiveness of enterprises. In general, there would be many advantages and few disadvantages.

Along with implementation of a technological contract responsibility system, there must also be reforms in the system of S&T job titles and promotion assessment, in the system of S&T wages, and in the system of rewards and penalties. With the reform of these systems, the nation can set a framework, localities can fix some rules and regulations, and units will have certain sovereign rights. With these three aspects unified, then it will be beneficial to the practice and perfection of the technological contract responsibility system.

12625
CSO: 4008/223

NATIONAL DEVELOPMENTS

REFORM OF SPECIALIZED RESEARCH INSTITUTES DISCUSSED

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 11, 12 Nov 84 pp 29-31

[Article by Luan Zaochun [2940 2483 2504], Heilongjiang Academy of Social Sciences; edited by Zhao Jian [6392 5329]: "On the Reform of Specialized Research Institutes"]

[Text] At the present time, China's specialized research institutes are set up according to the fundamental division of labor in their research work (basic research, applied research or developmental research), with the majority of them being independent research organizations. However, this kind of organizational setup is not completely suitable to the needs of China's scientific research work in modernization construction and requires further reform. This article sets out from the basic models of how various nations have achieved S&T progress in their own nations, and discusses in depth the direction of China's reform of its specialized research institutes.

I

S&T progress as a factor in contemporary socio-economic development has become increasingly striking, with S&T, capital and labor constituting the three major elements in economic development. In economically developed nations, science and technology have surpassed both capital and labor to occupy the number one position. For example, the United States has for the last 40 years had a 216 percent increase in production, compared to a 54 percent increase in labor input and a 102 percent increase in capital input (according to suo luo [4792 3157] formula calculations); in the production increase the use of S&T progress constituted 68 percent, whereas the use of capital and labor totaled 32 percent.[1]

It is common knowledge that S&T modernization is the key to China's four modernizations. However, S&T is still far from coming into its full key use in the construction of China's modernization. S&T progress employed as an element in our economic development is still relatively limited, in general constituting only about 20 to 30 percent. For example, in the period 1976-1981 at the Heilongjiang Light Spinning Company (according to calculations made on the Douglass neutral technological model), S&T progress constituted but 22 percent as an element in the value of production

increase, while capital and labor constituted as high as 78 percent. This instance makes it clear that the use of S&T progress is still not evident, and that in the task of carrying out the four modernizations, S&T cannot be on a par with capital and labor. But China is currently facing an enormous problem, namely that our national financial resources are inadequate, and our capital is seriously scattered. It is obvious that, in its construction modernization China cannot continue to follow the old road of relying chiefly on increases in capital and labor before producing, but must instead bring S&T into full use; there must be an annual increase in the proportion of S&T progress as a factor in the increased value of output, striving to make it constitute more than half.

How best to bring S&T into full use? How can we speed up the progress of S&T still more? These are major topics meriting careful study by China's S&T management community.

As a first step we present an analysis of the ways in which various other countries have achieved their own S&T progress. The nations of the world, when achieving their own nation's S&T progress and according to the specific national conditions of each, have for the most part chosen one of the following three different models.

(1) The Original Creation Model

This is the model chosen by the world's leading S&T nations. It puts its emphasis on relying on the nation's own strength to achieve S&T progress. The United States is representative of this category of nations. Owing to the high degree of development of the United States's S&T and industry, its scientific research and its ability to be technologically innovative are both stronger. The important technological inventions of the 20th Century, such as nylon, plastics, semiconductors, lasers, electronic computers, etc., were for the most part achieved initially in the United States. The United States is the world's leading technology-exporting nation: over the past 20 years, its ratio of technology exports to imports has been about 10:1.

(2) The Import Model

This is the model chosen by those nations having a fairly low level of S&T, and relatively backward industry. It stresses importing advanced technology from foreign nations in order to achieve progress in their own country. Japan is representative of this category of nations. After World War II, Japan's S&T and its industry were in a fairly backward state. However, Japan successfully carried out a policy of importing technology, and in less than 20 years had imported several tens of thousands of items of advanced technology from the United States and Western Europe, becoming the world's leading technology importing nation. (Coincidentally, its ratio of technology exports to imports is just about the exact opposite that of the United States, approximately 1:10) Japan then quickly achieved the progress of its own S&T, moving the level of its S&T and its industry into world leadership position. Comments from many nations have recognized the Japanese model as a successful one.[2]

(3) The Composite Model

This is a model chosen by nations having a relatively high level of S&T and a relatively developed industry. It utilizes a combination of the aforementioned two models, relying on one's own national scientific research strength as well as the importation of advanced foreign technology to achieve one's own S&T progress. Representative of this category are the Federal Republic of Germany, France and Great Britain. They do differ somewhat, however: the Federal Republic and France have laid particular emphasis on the importation model, with ratios of technology imports to exports being on the order of 7:3 and 6:4 respectively; for this reason their progress has been comparatively rapid. Great Britain has laid particular stress on the creation model, relatively conservative, maintaining a balance between technology imports and exports. Because of this its rate of progress in S&T has not been as rapid as that of the FRG and France.

The world's nations, according to the dissimilar circumstances of various historical periods, have adopted different models to achieve their S&T research. For example, during the 19th Century the United States employed the importation model, rather than the original creation model. At that time the United States was still a second-rate power among the world's nations, and was still importing advanced technology in quantity from such Western European nations as Great Britain and Germany. In the 1970's, after Japan had achieved modernization of its S&T and its industry, it was already moving toward the original creation model, stressing reliance on their own national strength to achieve technological progress.

Which model should China select to achieve its own S&T progress? Given our situation of being 20 to 30 years behind the advanced S&T nations, we know that we should adopt the importation model. That way we can catch up to the world's level of advancement within a relatively short period of time, while decreasing the time required for us to narrow the gap between China and that level. Moreover, given the considerable technological gap that exists between the advanced and backward regions of China, and between our advanced and backward departments, these also should go through the importation model, in order to achieve S&T progress in the more backward regions and departments. Therefore, the importation model has universal significance for the achievement of S&T progress in China. It includes not only the importation of foreign technology, but also the transfer of technology domestically. China's technological progress, then, can be achieved via the following three routes:

(1) Import major advanced foreign technology;

(2) Transfer advanced technology from the more advanced regions and departments to the backward ones;

(3) Transfer advanced technology from the military to the civilian sector.

For a fairly long period of time the original creation model will have to be relegated to a subordinate position in our research work.

The foregoing was an analysis of the principle methods employed by various world nations to achieve S&T progress in their countries, and the program that China should adopt. However, for many years under the guidance of the policy of "independence of action and self-reliance," a particular stress was laid on the original creation model in the work of advancing S&T work in China. So little attention was given either to importing advanced foreign technology or to transferring technology within the country. Although there has been a significant change in recent years, this aspect of the work is still very weak, with too slow a pace. The result has been that not only is there still a rather large gap between China and the international level of advancement, but there is also a large gap between the backward and advanced regions of China.

This situation must be changed: we must implement "bring-it-here-ism," that is, we must implement technology importation and technology transfer on a large scale, importing into China the advanced technology which the economically developed nations had already made universal in their nations by the 1970's and 1980's and which is appropriate for China. Moreover, we must popularize its expanded use throughout China. The State Council has decided to import 3,000 items of advanced technology from abroad, in order to lay a firm foundation for development of the national economy during the period of the Seventh 5-year Plan.[3] Some provinces and cities have also begun implementing cooperative technology development and transfer work: for example, Heilongjiang has signed a contract with Shanghai which calls for exchange and cooperation on more than 70 technological projects. Throughout the nation there has emerged a new phase in technology importation and technology transfer.

However, viewed from the standpoint of past experience, due to our not keeping up in many areas, some technological items have not produced the anticipated economic benefits. There has been some blindness in the work, with imported technology not fully digested. This has even reached the point of there being little reform in promoting the work after importation. One basic reason for this is the lack of research concerning the imported technology, and this is influenced by the system of research management we practice.

The work of importing foreign technology and transferring technology domestically is very strong work, having technological, policy and scientific aspects, and carrying with it a series of problems for study. Take for example the intelligence information work prior to importation, truly a case of knowing your opponent and yourself. This consists of choosing the technology to import and the object of importing that technology according to one's own needs (nation, company or enterprise). In other words, choosing what is called "appropriate technology." In the process of importing, we must do a good job of making a thorough and ongoing proof of the plan, and do a good job of technological and economic analysis, carrying out technological appraisal. After importation, we must organize research personnel and engineering technical personnel to research, digest and grasp

imported technology, bringing imported technology into full use. We should attain the technological level we belong at, and at the same time we must train operating personnel to master the correct management of imported technology. After an item of imported technology has attained results in a region or department, there should next follow a great deal of work at transferring technology and expanding its use. This work can also encounter a great many problems. According to the characteristics of each department and locality, we must choose the different material and craft routes to follow, solving some particular contradictions. If this series of problems is not resolved, it will be very difficult to popularize a particular item of technology across a wide area.

China's present research management system and planning work is not exactly that which is needed for the importation model to be at the center of achieving Chinese S&T progress. According to rough statistics, China has about 10,000 research organizations of all sizes; other than a very few that focus on fundamental theoretical research, the majority of these are comprehensive or specialized research institutes engaged in applied or developmental research. The overwhelming majority of these are independent research organizations, under the leadership of responsible departments, science commissions and science academies at all levels. In general, these research organizations do not have close relationships to industries and enterprises. The proportion of enterprise-related research institutes is only about one-fifth of the total, and the joint research-production type of institute is only just beginning to emerge in China, so there are still very few of these.

When examined from the standpoint of topic selection, these research organizations appear for the most part to be conducting their research on the original creation model, with very few including imported technology and technology transfer items among their research topics. It is also true, however, that these so-called original creation research topics have a considerable amount of duplication in various places, and are a long way from entering the research plans of all places. It is very difficult to enter imported technology and technology transfer items into research plans.

At the present China does not have any research organizations which are dedicated to the technology import and technology transfer model, nor does it have any research organizations which are dedicated to the work of transforming the technology of industries and enterprises. The vast majority of medium and small enterprises feel deeply their lack of S&T strength, so it is very difficult for them to enter into any meaningful technological transformation. As a result the backward situation of our factories cannot be changed, and expanded production often slips down the old road of "postponing expansion of what is within the plant."

In light of the foregoing analysis of the current situation of foreign and domestic experiences and China's specialized research institutes, it appears that in order to make any progress in Chinese S&T and put expanded production at the focus, it is essential that we remove the research system barriers that lie in the path of technology importation and transfer work.

We must also implement reform of the specialized research institutes we have now. What follows are several vague ideas of mine on the direction reform of China's research institutes should take.

(1) Expand the research organization of enterprises. Within those industries and enterprises which have the proper conditions, we should increase the establishment of research institutes and offices, experimental offices and stations, trial production workshops, etc., with special attention given to setting up experimental offices and trial production workshops. This is to more closely relate research and production work. This would promote the power of industries and enterprises to bring forth new technological ideas and technological transformation. It would also speed up the pace at which new technological ideas and new products are brought into production, and thereby reduce the research system cycle. As much as possible, we should merge presently independent specialized research institutes with businesses or industries which are similar to the institutes in their specialties.

(2) Increase the integration of research with production. Within large-scale, comprehensive research institutes, we should set up research that is integrated with production. This will assure that the research work of the institutes is closely integrated with the technological progress and technological transfer work of the plants and industries with which they are affiliated.

(3) Departments which are concerned with the management of S&T plans should assign to various specialized research institutes projects which involve technological importation and transfer. Various enterprises' research institutes can also opt for topics which involve technological transformation, importation and transfer; these can then be reported to higher authorities and so be placed in the national research plan.

(4) Make it clear that the various specialized research institutes above all else should, within an extended period of time (say, 10 to 20 years) make the mission of technologically transforming enterprises their own chief research direction and principle research topic.

(5) The work of pupularizing technology should be one of the chief research jobs of specialized research institutes.

(6) Within a province, city or locality, there should be designated a comprehensive research organization which is dedicated to the development and progress of technology within that locality. This organization will not be engaged in specific research work, but will be concerned chiefly with S&T consulting and cooperative work, research which is on the frontier of that locality's technological progress and general and specific policies. It will also be engaged in technological progress and transformation planning. This will be a "soft science" research institute.

Besides this, the nation should formulate relevant policies, to ensure that the work of technology transformation and importation goes forward smoothly.

BIBLIOGRAPHY

1. Sang Gengtao [2718 6342 7118], "Appraising the Use of S&T Progress in Economic Development," WAIGUO JINGJI GUANLI [FOREIGN ECONOMIC MANAGEMENT], No 1, 1983.

2. Nihon Jingji Xinwenshe. CHENGGONG TI JILU [A RECORD OF SUCCESS]. Xin Hua Chubanshe, 1982.

3. "Be Bold in 'Bringing it Here'." JINGJI RIBAO editorial, 27 Jun 1983.

12625
CSO: 4008/223

NATIONAL DEVELOPMENTS

S&T REFORM RAISES THEORETICAL QUESTIONS

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF SCIENCE AND TECHNOLOGY] in Chinese No 11, 12 Nov 84 p 1

[Article by Zhen Qinghan [6774 1987 3352], Yunnan Science and Technology Commission, edited by Ke Ren [0668 0086]: "Give Serious Study to Theoretical Questions Arising From S&T Reform"]

[Text] Right now, the spring breeze of S&T reform is blowing across the land, but in practice this reform is raising many questions which urgently require solution. We feel that some of these problems are so wide ranging, so profound, that they merit a high degree of attention. For example:

1. In order to overcome the malpractice of divorcing science and technology from economics, some localities have added layer upon layer of S&T leading small groups, while some other localities have simultaneously entrusted their S&T economic work to one leading comrade. In practice these approaches appear to have produced little in the way of results. Fundamentally, in the long run, what S&T leadership system should we actually establish?

2. In order to resolve the problem of dispersal of our S&T strength, the problem of the "five frontline armies" that cannot be formed into a fist, everyone is pondering how to strengthen unified leadership and organizational cooperation, which naturally are essentials. However, how can this be possible until S&T work has the status of "controlled yet not dead, living yet not wild." How does this determine S&T's frontline "unity" versus "dispersal," "managing" versus "giving free rein."

3. At present, in order to integrate the management of S&T cadres with the management of S&T missions, the central government has set up S&T cadre departments in various provincial, municipal and autonomous areas, and has put these under the leadership of the S&T Commission. However, still to be resolved is the problem of S&T funding and financial management being out of line with the management of S&T missions. If, in order to solve this problem, there were established a "Department of S&T Funding" or "Department of S&T Financing," would it conflict with the S&T Commission?

4. There are currently some comrades who advocate the separation of research organizations in enterprises, converting these instead into independent research units; some other comrades believe that independent research units

should be incorporated into enterprises, changing them into dependent research organizations; many locations are establishing "research and production combinations," with a variety of forms and a multitude of names. Setting out from China's specific situation, according to the objective needs of S&T and economic development, where actually is the point where research and development should merge? If we wish to implement a policy of "many features co-existing," what then is the objective basis for this?

5. Along with the development of research reform, many localities have come up with both collective and individual research institutes; what is the objective basis for these, in their economic and research aspects? What is their developmental future? How should the nation manage them? In the emergence and development of collective and individual research institutes, what is their relationship to what people often refer to as their entering a national, even international research phase?

6. At the present time, the great majority of research institutes which have implemented paid contracts and economic independence are institutes which are engaged in industrial research and development; there is considerable controversy whether institutes engaged in research and development for agriculture (including farming, forestry, water and air) can do this. Starting out from the special characteristics of the rural economy, societal conditions and agricultural research, how then actually should agricultural research institutes implement reform?

7. Many enterprises are now implementing the factory director responsibility system. But while the labor unions are powerful organizations, research and other institutions implementing the director responsibility system do not have a comparably powerful organization. Based on the special characteristics of S&T activities and management, should research academies and institutes implement so powerful a closed system among themselves? Other than elections, initiative and recall, or recommending dismissal of academy or institute directors, does doing it this way insure, from the management system standpoint, that the masses are exerting constant supervision, restriction and management of the director? And how does this bring about democratic management of the institute?

8. As everyone knows, S&T personnel certainly do not work hard for individual material benefits alone. However, in the present S&T reform program authorship of an article is usually in itself insufficient material benefit. What is the best way in S&T reform to genuinely embody the principle of this motivating spirit? And in this matter of spirit, which "special policies" should be implemented that will sufficiently arouse the enthusiasm of S&T personnel?

9. At the present time many localities, departments and units are competing in formulating and adapting special policies and measures which are aimed at attracting and stabilizing S&T personnel. The struggle between the "mobile" and "immobile" is fairly intense. Viewed from the standpoint of the whole development of science and technology, and the economy as a whole, and the long term benefits to these, what actually is the mechanism

for the mobility and stability of S&T personnel? How does one handle the relationship between program assignments and freedom of movement?

10. How policy is formulated in S&T reform also raises new requirements. At present, a large number of localities and departments allocate reward funds, float wage quotas and enjoy special remuneration for a fixed number of years, etc., all very strictly regulated. This situation has changed slightly, with hasty revisions carried out that have resulted in a situation whereby an earlier regulation will not yet have taken effect at the time that a later regulation is promulgated. This confronts us with a serious theoretical problem: faced with a complex and changeable objective situation, how should we in our S&T reform research, formulate and revise S&T policy so as to assure the policy's relative stability and authoritativeness?

The great upsurge of S&T reform has now begun. It is a matter of the utmost urgency that we solve the important theoretical problems related to this reform. For this reason, we recommend that concerned departments, especially leading S&T departments, organize workers concerned with theoretical studies of science and S&T management cadres in the actual practice of S&T reform, that they unceasingly summarize their experiences, so that wide-ranging discussions and thorough research will be carried on step by step in a planned way, and guide the healthy development of S&T reform.

12625
CSO: 4008/223

NATIONAL DEVELOPMENTS

HEILONGJIANG'S STRATEGY TO DEVELOP INTELLECTUAL RESOURCES DISCUSSED

Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 1, Jan 85, pp 5-9

[Article by Hu Xiangming [5170 4382 2494] of the Science and Technology Association of Heilongjiang: "Essence of the New Technical Revolution and Heilongjiang's Strategy To Develop Intellectual Resources"]

[Text] I. Essence of the New Technical Revolution in the World

The western world is widely talking about the so-called "third wave" or the "fourth industrial revolution." This new industrial revolution is characterized by the wide use of new technologies such as computer, genetic engineering, optical fiber, laser and ocean exploitation. Some western experts and scholars believe that we are already in an information society. The source of power is no longer wealth controlled by the minority. Instead, it is information which is available to the majority. Knowledge has become the key to productivity, competitiveness and economic achievement. The increase in value is no longer accomplished by labor, but by knowledge. The mainstream of an information society is the "intelligence industry" and its core is the "knowledge industry." Information related industries will emerge as the "fourth industry." Science and technology, intelligence, information and intellects will have a significant role in these industries. This is considered to be the focal point of the strategy for economic development and achievement.

In our opinion, science and technology, intelligence, knowledge and information are the driving force behind the so-called "information society" or "third wave". New technologies evolved in this new technical revolution, such as computer, laser and fiber optics, represent the power to materialize knowledge. The wide application of computers and the further development of artificial intelligence, on the other hand, are developing human intellectual resources to add new dimensions to the human brain to produce "live knowledge." The entire process of this technical revolution is: intelligence exploitation -- new computer-based technology -- developing intelligence. Intelligence exploitation is the foundation and cause of this new technical revolution and developing intelligence is the result and objective of this revolution. Intelligence exploitation -- new computer-based technology -- developing intelligence not only highlights the essence of this technical

revolution, but also reflects the pattern of initiation and evolution of this technical revolution. This point has already been proven by the economic take-off in the U.S. and Japan. Based on this model, we realize that "exploitation of intelligence" is the strong driving force for the new technical revolution. It is also the basic policy of China to meet the challenge of the new technical revolution. It is urgent to objectively analyze the intellectual resources in Heilongjiang and to accurately formulate a strategy in order to meet this challenge.

II. Status of Heilongjiang's Intellectual Resources

The number, structure and developing trend of the major carrier of Heilongjiang's intellectual resources are as follows:

1. The province has 320,000 technical personnel (including 60,000 in departments under the jurisdiction of the central government and not including social science workers), which is 1/23 of the total technical force in China. It ranks fifth in China in terms of the number of technical persons per 10,000 population. However, in terms of the number of technical personnel per 100 employees, it approximately ranks fifth from the bottom. This indicates that: (1) there is a large number of provincial employees and (2) the intellectual quality of the employees is poor. Approximately 80 percent of the 15,000 industries in Heilongjiang do not have college graduates. Among 800,000 employees in business and finance, there are only 3,000 college students; approximately 0.38 percent. This does not agree with the requirements of technical reform and economic benefit improvement in industries. In addition to irrational pricing structure and improper management, poor intellectual quality and low relative proportion of technical personnel are the major cause of the "large advantage, poor yield" economy in Heilongjiang.

The number of technical personnel per 100 employees in Heilongjiang also grows slower as compared to that in other areas in China. It is next to last in the country. In addition, intellectual resources are flowing away. We must further implement the policy for intellectuals.

2. The distribution of technical personnel does not meet the needs for economic development. The distribution of technical personnel is shown in Table 1.

Table 1. Composition of Heilongjiang's Technical Personnel in 1983

	total	engineering	agriculture	research	sanitary	teaching
total	327,000	130,000	24,000	11,000	93,000	69,000
percent(%)	100	40	7	4	28	21

There is a shortage of technical people in agriculture, forestry, building materials, mining, light industries, food, textile and microelectronics which are urgently needed for the construction of the five bases; 40 percent of the population in Heilongjiang is in agriculture. It is one of the major commercial grain market in China. However, there are only 24,000 agricultural

technical people, 1.7 per 10,000. This is much lower than the national average, as well as those in developed countries and other regions in China.

As the new technical revolution progresses, promotion of the wide application of microelectronics is becoming more important. Heilongjiang has a serious shortage of experts in microelectronics. According to statistics, there are less than 500 microcomputer software people, approximately 3.3 percent of the total force in China. There are only 10 senior level and 100 middle level technical people.

3. The technical team has relatively low academic training and its ability shows a declining trend (see Tables 2 and 3).

Table 2. Comparison of Schooling of Heilongjiang's Technical Personnel with that of China.

schooling\ comparison	China (%)	Heilongjiang (%)
college	39.4	33
high school	37.3	43
below high school	13.3	24

Table 3. Academic Background of Different Types of Technical Personnel.

classification\ schooling	college (%)	high school (%)	below (%)
research	66.8	26.4	6.8
engineering	37.2	42.3	19.5
agriculture	24.6	50.6	24.8
sanitary	24.4	42.8	32.8
teaching	37.19	42.5	20.6

From these two tables, we can see that the academic training of the technical force in Heilongjiang is not adequate. Approximately 1/3 of them went to college, which is below the Chinese national average. This is particularly serious in agriculture and sanitary. In addition, the technical team in Heilongjiang is not engaged in advanced studies, especially in the age groups 36-45 and 46-55. These technical people are college graduates in the 50's and 60's. As "knowledge explosion" progresses, the "rate of obsolete knowledge" is rapidly increasing. Someone did a statistical analysis and found that 40 percent of the knowledge learned in the 1960's is out of date. Approximately 50 percent of the knowledge learned in the 1970's will become obsolete in the next 5 years. Based on this analysis, the knowledge learned by these two age groups of technical people will be completely out of date. As for computer knowledge, it is almost a blank.

4. The age structure is irrational, which will lead to a crisis of the absolute number of middle-aged key personnel in the near future. Table 4 shows the agedistributionof technical personnel in Heilongjiang (not including departments under the direct jurisdiction of the central government).

Table 4. Proportion of Technical Personnel in Heilongjiang by Age

age group	technical personnel	percentage of total (%)
60	1,000	0.5
56-60	4,000	1.7
46-55	56,000	21.0
36-45	83,000	31.4
under 35	84,000	31.7
total	260,000	100

(Note: The 26-34 age group is approximately 20 percent of the total technical force.)

The age structure of the technical personnel in Heilongjiang is that there are fewer people on both ends and more people in the middle. This irrational structure is caused by the 10 years of chaos. By 1995, the 36-45 age group will drop from the 31.4 percent of the total to around 20 percent, creating a middle-aged key personnel crisis.

5. The job title structure is partially irrational. The ratio of senior to mid-level to junior job title is 1:18:85 in Heilongjiang's technical force. However, there are many problems if we specifically analyze each category. The job title in research is out of proportion. The ratio is 3.5:51.3:35=1:15:10. There is a serious bulge in the middle level, resulting in waste of talents. There is an obvious deficiency in the junior level. The proportion of the entire research team is seriously out of balance. (2) The job title in the teaching team is imbalanced; 1.1 percent in senior level, 6.2 in mid level and 92.7 in junior level. The reasons for the huge number of junior teachers are that qualified junior teachers are not yet promoted and many teachers are hired in recent years by vocational schools. In some institutions of higher learning, seniors are teaching lower classes. (3) There is a serious shortage of senior level engineers and agricultural technicians (senior level engineers only constitute 0.43 percent of the total engineers and senior agricultural technicians only 0.37 percent). The ratio of middle level to junior level technical personnel is not in balance (1:2.5 for engineers and 1:3.5 for agricultural technicians). The small proportion of junior level technical personnel undoubtedly will force some middle level people to perform junior level assignments, resulting in the waste of talents.

III. Strategy To Develop Intellectual Resources in Heilongjiang

Exploitation of intelligence is a systems engineering which involves many macroscopic and microscopic factors in science and technology, economy, society, education, structure reform and policymaking. In this paper, we will discuss some ideas regarding the strategy to develop intellects in Heilongjiang from the macroscopic point of view.

First, the traditional economic development strategy must fundamentally be changed. In the past 30 years, the strategy adopted is based on the model of continuous investment of manpower and capital to expand production. It is

essentially focused on the "development of materials." Internally, each unit is self-sufficient regardless of the size. Externally, each unit is isolated. This is the reason for the consequence of "large advantage and poor yield." Since the Third Plenum, "Leftist" ideology has been swept aside. We began to adopt the model of promoting economic development and expanding productivity by making technical advances. I believe that this strategy is essentially based on the "development of intelligence." This is a significant change as compared to the old concept. In order to make the economy of Heilongjiang meet the needs for the technical revolution, it is necessary to give priorities to the development of intellectual resources and advancement of science and technology.

Second, an overall strategy of "using intelligence to develop intelligence" must be adopted. Development of intellectual resources, similar to exploitation of material resources, requires a certain investment. But, the current financial situation of the province does not permit us to invest a great deal of capital. This is a contradiction. By the end of this century, the annual agricultural and industrial output of the province is expected to grow to 3.5 times the level in 1980 by improving the yield. The industrial growth is expected to be 3.48 times. Based on empirical estimation and linear extrapolation, there is a need to increase at least 400,000 engineers in addition to the 130,000 current engineers. This is calculated based on a 90 percent increase of technical personnel as the industrial productivity of China increased by 100 percent between 1953-1957. According to the current cost of 8,000-10,000 yuans to put a student through a four-year college in science and engineering, we have to invest 4 billion yuans. This is obviously a difficult thing to do. The only solution is to adopt a strategy to "use intelligence to develop intelligence". In other words, this is a strategy to use live knowledge to develop intelligence. I believe the specific counter-measures are:

1. Tap the potential of higher education to improve efficiency. In developed countries, the average number of students per faculty member is high. For instance, it is 31 in the U.S., 20 in France, 16 in Yugoslavia, 14 in the USSR and 11 in Japan. This ratio is 1:5.1 in China and only 1:3.5 in Heilongjiang (supposed to be 1:6 according to regulation). This indicates that our education efficiency is poor. Based on a comparison of the statistics of Harbin Polytechnical University with that of UCLA in 1982 (see Table 5), Harbin Polytechnical University has far more faculty, staff and building space than UCLA. However, the latter has several times more students than the former. This fact indicates that with some adjustment there is a huge potential to increase the number of students. Let us use Harbin Polytechnical University as an example, its 1983 admission goal was 424 students. In reality, 672 students were admitted by adopting a local student commute system and other financial aid methods, expanding the enrollment by 52 percent. If all 36 institutions of higher learning in Heilongjiang can follow this approach, based on the 1:5 ratio, we can accept 4,000 to 5,000 students each year.

Table 5

school	teachers	staff	space	books	departments	students	ratio
Harbin Polytech. Univ.	app.1,300 (960 lecturers 400 assistants)	3,200	650,000 sq meters	650,000	9 (with 29 fields)	4,000 including 200 graduate students	1:3.1
UCLA	app.1,300 850 full time 500 part time	1600 (1/3 regular 2/3 temporary)	250,000 sq meters	700,000	50	25,000 including 8,000 graduate students	1:19

2. Take full advantage of the function of academic societies as an "intelligence pool." The provincial technical association systems has 95 societies of natural sciences with over 30,000 members nation wide above the middle level. There are 46,000 technical personnel above the middle level in Heilongjiang and 3/4 of them are members of natural sciences societies. There are over 80,000 members in various local societies, approximately 1/4 of the 320,000 provincial employees. This is a huge intellectual resource. Superficially, a scientific society has a loose structure. However, it has lateral contacts. It is possible to organize the vast membership through academic exchange, scientific popularization, technical discussion, consulting and continuing education to become an "intelligence pool." There are two ways to exploit this type of intellectual resources. One is to organize retired and under-utilized technical personnel to take advantage of their "residual value." In addition, we can also exploit intellectual resources beyond the 8 hour limit. Second, we can break the system through lateral contact to organize technical personnel of different disciplines and specialties to create a new network for a new product.

3. Establish a sound part-time higher education network. As mentioned above, there will be a key personnel crisis by 1995. In order to ensure the quadrupling of the total productivity by the end of the century, to alleviate the shortage of the "third echelon" of technical personnel and to maintain the continuity of the entire team 10 years later, it is an urgent strategy to establish a comprehensive part-time higher education system. The system can be created by the following five networks:

(1) a network of correspondence school and night school offered by full time universities, (2) the TV and radio college network, (3) industrial employee university network, (4) a network of management schools and Communist Party schools and (5) continuing education center for technical personnel operated by the association of science and technology.

The focal point is to train people in the 24 to 35 age group.

Third, the focus should be placed on the exploitation of intellectual resources in middle age technical personnel. In Heilongjiang, 52.4 percent of

the technical personnel are in the age groups 36-45 and 46-55. Therefore, the focal point of intelligence exploitation should be placed on middle-aged people. They are in their most productive stage of their career. It is strategically significant to exploit their intellectual resources. According to Professor William James of Harvard University, a person can utilize 80-90 percent of his potential by self-motivation. Otherwise, he can only utilize 20-30 percent of his potential. Currently, personal motivation of the technical personnel in Heilongjiang is not utilized to the full extent. According to a survey performed on over 30,000 technical workers last year, only 1/5 of them are aggressive and 3/5 of them are somewhat aggressive; 1/5 of them are not enthusiastic at all. General problems affecting the enthusiasm of the technical personnel in Heilongjiang include the irrational management system, poor living condition, unreasonable assignment and linkering "Leftist" ideology in the leadership. Therefore, the policy of taking care of the intellect should be implemented in order to exploit the intellectual resources.

Fourth, revolutionize the traditional education philosophy and reform higher education. I believe that the major thrust of education reform should be focused on training new talents for the new technical revolution.

1. Change the traditional education philosophy. As the new technical revolution evolves, the traditional Chinese education philosophy (which based education solely on acquiring knowledge) can no longer meet the needs of the era. We should put the emphases of education on training students the abilities to create, adapt, use their hands and utilize knowledge comprehensively. As computers are widely used, memorization of knowledge can be done by computers. We can no longer ask our brains to acts as computer memories. A foreign educator said the an illiterate in the future is not a person who cannot recognize words, but a person who did not learn how to study. Chinese scientist Qian Weichang [6929 0251 7022] also mentioned that college education is to teach students to learn by themselves. Therefore, we should change from 80 percent lecturing and 20 percent learning to 80 percent studying and 20 percent lecturing. "To learn how to study" is an urgent matter to be resolved in the school and it is also an important link in the strategy to develop intellectual resources.

2. Residual faculty resources in traditional science should be shifted to new and leading edge disciplines. The faculty strength in traditional disciplines is fairly strong in Heilongjiang. We should utilize excess manpower in new and leading edge disciplines, especially the most important ones involved in the new technical revolution such as computer science, bioengineering, new materials and ocean exploitation.

3. We should train more people with specialty and computer know-how. College students in Japan, United States, England and West Germany spend 10-19 hours per week on computers. If China wants to use computer in technology reform and economic benefit improvement, we must train more people with knowledge in both areas.

References

[1] Guan Shixu [7070 1102 4958] editor, Selected Information on the New Technical Revolution, Harbin Polytechnical University Press, 1984 pp 59, 97

[2] Zheng Yefu [6774 0048 1133], Number, Composition and Distribution of Intellects in China, Encyclopedia of Knowledge, Vol 5, 1984

[3] Na Yiman [4780 0122 2581], Investigation of Higher Education in the World, Education Science Press, 1982 p 66

[4] Sun Kuiwen [1327 1145 2429], Investigation on the Strategy for Heilongjiang's Economic Development, Industrial Economy, Vol 2, 1984

[5] Luo Nan [5012 0589], Operating School by Various Means Is an Effective Way To Accelerate the Development of Higher Education, Research on Heilongjiang's Higher Education, Vol 4, 1983

12553
CSO:4008/209

NATIONAL DEVELOPMENTS

TECHNICAL MANAGEMENT OF INSTRUMENTS IN RESEARCH INSTITUTES

Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 1, Jan 85 pp 74-76, 73

[Article by Wu Runyu [0702 3387 1342], Qin Shichang [4440 1102 2490], An Yuzhang [1344 3768 3864] and Fan Shuxun [5400 2885 0534] of the Institute of Electronics of Chinese Academy of Sciences: "Technical Management of Instruments in Scientific Research Institutes"]

[Text] I. Technical Management of Instruments

In the past, management of instruments primarily involves how to supply laboratories with instruments, what kind of instruments to buy and tracking the instruments. This type of management is administrative or quantity management because it is responsible for the type and quantity of instruments.

The quality of instruments is crucial in scientific research. Parameters judging the quality of an instrument, such as accuracy, stability, adjustable range and reliability, change with usage. In most cases, they are deteriorating. Unnoticed deterioration of instrument quality at a key moment, may result in a serious loss of research data. Modern research imposes a higher requirement for instrument quality. Accuracy and reliability of the instrument are important in actual applications. The primary responsibility of instrument management is currently focused on improving the rate of utilization and rate of readiness. These requirement belongs to the domain of readiness. This type of quality-related management is called quality management. In order to differentiate it from quality control of products by manufacturers, it is called technical management in this paper.

II. Status of Instrument Quality in Scientific Research Institutes

The reason that technical management of instrument must be stressed is because the status of instrument quality in research institutes is not good. Let us give the following examples:

1. An outfit tested and calibrated some oscilloscopes (a total of 30 units in 12 models used by 4 laboratories) and found that only 8 units met the original specifications (27%). The remaining 22 units (73%) had to be repaired to meet technical specifications.

2. A unit purchased a Model SQ-4 sampling oscilloscope (worth 35,000 yuans). It did not work from the day it was received. It was sent back to the factory for repair and the factory also sent technician to the unit to check it out. This instrument had never been operational until the day it was scrapped.

3. According to a 1982 statistics, a unit had five similar dc weak signal amplifiers (in 5 models from 4 countries). Two of them are totally down and two are in service with malfunctions (unable to meet original specifications but barely operational). One unit is waiting for its manual.

4. An outfit purchased (received) 66 power supplies between May 1980 and April 1981. After incoming inspection, only 31 were qualified (47%). Among the remaining 35, 14 are out of specification. There is no reply to 2 units after the manufacturer was notified. One unit was rejected and the manufacturer sent someone to replace the unit. 2 units were repaired by servicemen sent by the manufacturer. 3 units underwent major repair by the technician in the outfit (with parts sent by the manufacturer for 1 unit) to meet the specification. In addition, 13 more units were purchased directly by the end user departments without being inspected.

There many more instances, perhaps more typical and prominent.

These results may be viewed as an overall picture of instrument quality in a certain outfit and may not be considered as the status of instrument in all research institutes. However, we realize that the quality of instrument did not receive the kind of attention it deserves in some organizations. Therefore, there is a need to seriously discuss technical management of instruments.

III. Effect of Technical Management of Instruments

Technical management of instruments includes maintenance and calibration, which assures that instruments are in good condition (use value). For instance, according to a report presented by an institute in the Instrument Workshop of Chinese Academy of Sciences in July 1981, the total value of repaired and calibrated instruments (un-depreciated) since 1978 (until end of 1980) is equal to the total expense spent by the institute on purchasing instruments in those 3 years. But, this is only one side of the effect of technical management (including affiliated technical work). This function is easy to understand. The more important aspect of technical management is often neglected in scientific research institutes, i.e. dynamic information feedback of instrument quality.

In the past, we relied too much on product catalogs, exhibitions and certifying conferences to order instruments. Information delivered through these conduits can only reflect the technical performance of an instrument at a certain time. This is the static information on instrument quality. If the buyer relies solely on this information to evaluate the instrument, its quality cannot be assured. For example, an outfit bought a RLC bridge from a famous foreign manufacturer in the 1960's. The accuracy specification is very high. However, the readout device broke down frequently. It was discovered that the cause is its weak internal transmission mechanism. The structure is

so compact that there is no way to solve this problem. Static information cannot tell us which manufacturer's product is trouble free, which is easy to repair and which has complete sets of data. Information capable of reflecting the technical quality of an instrument in use, especially information on the changing pattern of instrument quality, is called the dynamic information of instrument quality. Dynamic information on instrument quality can only be totally reflected in technical management of instruments (including technical work). Dynamic information on instrument quality is a more scientific basis for ordering instruments. The dynamic information for evaluating instruments is called dynamic instrument quality information feedback. If we consider that the objective of maintenance and repair is to fix existing quality problems, then the objective of dynamic information feedback in technical management is to minimize or avoid recurrence of quality problems. We must use dynamic information provided by the technical work as the scientific basis for instrument management. The duty of the technical work is to provide dynamic information. This is the most important difference between the technical management of instruments in research institutes (including maintenance and repair) and commercial service centers (such as service centers).

We can see that technical management of instruments is centered around readiness. It is the gauge to judge the success of technical management. It should be pointed out that the primary problem in some institutes is not the low rate of readiness, but the lack of the concept of the rate of readiness. In these institutes, the first thing to do is to be able to answer the rate of readiness. Or, the first step should bring the establishment of technical management to the agenda.

IV. Technical Management of Instruments

In a scientific research institute, technical work on instruments includes testing, calibration and maintenance. The management of this technical work is called technical management. There are differences between them. However, they are also related.

In a research institute, the person who uses an instrument must be responsible for the quality of the instrument. The instrument itself will be responsible for the scientific experiment. Therefore, it is necessary to have technical management to test, calibrate and maintain every instrument. Is every institute responsible for the calibration and maintenance of each instrument it owns? The answer is probably not. This may not even be feasible. A research institute uses a variety of instruments because each field involves a mixture of disciplines. Moreover, the quantity of each type of instrument may be limited. For instance, research institutes in biology may use a few electronic instruments and are not equipped to calibrate and repair these instrument. Electronic research institutes may use a few optical instrument and are not capable of calibrating and repairing these instruments. This type of work can be resolved through technical collaboration among institutes. If an outfit has only a few pieces of equipment, then the entire instrument repair work can be done through technical collaboration. The technical management work to determine and arrange which instrument to repair and which to test, however, must be done by the user institute. The content of the technical work must be determined by weighing the economic benefit of the

institute. As for the measure of the ultimate technical basis for instrument checking, it must be determined by the rate of utilization. When the utilization is not very high, we should consider collaborating with other institutes.

People in technical management of instrument can also perform the technical work. However, it should be made clear that in this case the same person is performing two jobs of different nature. This is not to complicate the problem. Instead, this should clarify technical management of instruments to meet future needs.

V. Two Fine Details

This is a lesson of two specific problems.

1. Inspection System

The inspection of instruments in a research institute not only should be done by a relatively independent system of personnel, equipment and standards but also should be arranged as a comprehensive program to ensure the readiness of the instruments. Inspection must be scheduled at least in the following three cases as a rule:

First, incoming inspection.

After a new instrument arrives, the user institute not only should check the instrument, its accessories, spare parts, manuals and packaging but also should quantitively inspect the technical performance of the instrument according to the manufacturer's specifications. Some institutes did not open their newly acquired instruments until the warranty period had expired. Then, they discovered quality related problems. Some instruments even could not be used at all. By that time, the manufacturer is no longer responsible and the end user is suffering the loss. In some cases, due to unreasonably long procurement procedures, the warranty period had expired when the instrument arrived, making it impossible to ensure quality by economic measures.

Second, periodic routine testing and calibration of instruments.

In a scientific research project, the experimental data was found to be substantially different from the projected value. After repeated testing and by almost taking the entire power supply apart, it was discovered that a DT-830 voltmeter (in use for about a year) was the problem. Its reading is too high (reading 170 volts at 98 volts, 80% error). If there is a periodic instrument inspection system, this kind of mishaps will not occur.

Third, calibration after repair.

Part or all the specifications of the instrument related to the repair job must be checked after the repair is done. This is also an inspection on the repair work.

In addition, there are other inspections, such as those for special user applications.

2. Guiding Ideology for Maintenance

In a research institute, a comprehensive instrument maintenance program should be put in place according to the entire layout of instruments. The arrangement should be made based on the long-term development of instruments. There are two issues to be discussed here.

First, the way to develop technical skill to maintain and repair instruments in a research institute is to grasp the general rule (or method) of instrument maintenance.

The general rule is to master the basic operating principles of instruments. The trouble spot is located and eliminated based on a step-by-step trouble shooting procedure in conjunction with the understanding of the principle. Contrary to this approach, there are specialized and professional techniques. These methods are geared toward one or a few types of instruments. A fixed procedure is established based on a great deal of experience and data acquired to determine the problem. Or, the problem may even be identified based on the phenomenon. This is a process to turn a technician into a skilled craftsman. The acquisition of experience and data can be completed in the instrument development process. However, a research institute may have a few units each of a wide variety of types of instruments. Furthermore, there are new instruments (new model and new principle) and fast turn overs. The craftsmanship approach is most probably not appropriate. This is significantly different from a manufacturer producing a few models of instruments in large quantities.

Second, maintenance should primarily be performed by technical personnel.

Repair of instruments in a research institute involves a great deal of fundamental knowledge (for a vast variety of instruments). Therefore, it is necessary to be staffed with enough trained professionals.

12553
CSO:4008/209

NATIONAL DEVELOPMENTS

TECHNOLOGY IMPORT PROBLEMS VIEWED THROUGH SHANGHAI'S EXPERIENCE

Beijing RENMIN RIBAO in Chinese 3 May 85 p 2

[Article by Zhang Shihong [4545 0013 7703]: "A Noteworthy Issue; Digestion, Absorption and Renewal in Technology Importation as Viewed From Shanghai"]

[Text] China has been importing more and more foreign equipment and technology in recent years, which is something necessary if we are to push for a realization of the four modernizations at an early date. But the current issue is this: the work of digestion, absorption, and renewal is not keeping up. Thus, economic returns after we import technology are never ideal and upgrading of our own S&T levels is too slow.

What needs to be done after importation? How are we to take something from someone else and make it our own, and through digestion, absorption and renewal upgrade our own S&T levels to the point at which we ultimately achieve the goal of producing it ourselves? This issue has not had enough of an impact on the minds of many people.

Currently, there is a skewed understanding of importation which holds it sufficient merely to use the imported technology and get from it an immediate benefit. Some enterprises have gone so far as to "keep secret" the advanced technology they have imported, with the result that not only is the same thing imported a number of times throughout industry, but the technology itself does not achieve the results it promises. Importation without digestion cannot help but create a dependence on foreign technology. With technological changes now rapidly taking place before our eyes, once an imported technology falls behind, we must continue to import more. This is especially the case for parts and components we cannot ourselves produce; and the amount of foreign exchange spent on such things is uncountable. A survey in Shanghai revealed that while the amount of money spent on importing a production line is within bounds, the amount spent on spare parts is a "bottomless pit," and the amount of foreign exchange spent on them in 2 or 3 years may be more than the original outlay.

In actual fact, technology importation's true benefit cannot come about except through digestion, absorption and renewal. Some of Shanghai's businesses which have excelled at the work of digesting technology have had this sweet experience. For example, after the Shanghai People's Appliance Factory imported manufacturing technology for low-voltage appliances, it immediately went to work to use this technology to upgrade its old plant and fabricated its own new equipment. When domestic raw materials or original equipment proved ill-adapted to the new plant, they worked closely with domestic factories producing those raw materials and successfully tested out production of six new materials, all of which proved to meet quality specifications assayed. This not only spurred product innovation; it also greatly accelerated the technological transformation of the entire business and sparked developments in the production technology of domestic raw materials and basic components. The return on all of this can hardly be calculated in terms of immediate income.

Attention to the work of digesting imported technology has been growing within economic departments in Shanghai. A survey of eight Shanghai industrial bureaus shows that of 489 pieces of advanced technology imported between 1980 and 1982, over 200 had shown promised results by last year. Once they had been digested and absorbed, they were able to turn out new equipment with special Chinese features. The work of digesting technology started off in Shanghai's basic-level enterprises on their own. However, now there are the beginnings of collaboration within industries, including integrated development of a number of priority products. This means organizing major factories, subfactories, raw material and parts factories, along with research units and technical schools for the systematic development of technology. This can assure systematic integration of product development and coordination between individual links. For example, the Shanghai Textiles Bureau has formally designated study of the work of digestion and absorption as a priority project and earmarked a sum of money for research expenditures. Four small groups devoted to bringing together digestion and absorption have been established, with members coming from research units, technical colleges, mechanized manufacturing plants and units importing equipment. These have set up an agenda of priorities, split up the work of digestion, and set specific dates for exchange of experiences. This means the creation of collective experience and that S&T results can become a collective wealth. Now simple topics for two advanced looms have already undergone appraisal, which is a major breakthrough in the textile industry's grasp of advanced technology. Many researchers have put together feasible first-hand technical manuals through digestion and absorption and have improved themselves rapidly. They say that the advantages of these materials surpass those of either investigation abroad or refresher courses.

The gradual formation of a force engaged in digestion, absorption and renewal of technology now underway in Shanghai is welcome news.

Shanghai is also preparing to make the results of its digestion of technology available nationwide on a continual basis. If this project is to go forward, some problems currently faced need quick resolution. One is to bring about a unified recognition of the significance of the work of digesting technology and further eradication of departmental selfishness and concern for immediate interests. Second is establishment of a single leading body to oversee the digestion work. Third is that there should be a set of clear economic policies of which the first must deal with problems of operating expenses in large projects. Many people feel that money spent on this front is worth more than that spent blindly importing equipment over and over. Fourth, there should be policies for protecting and results of the absorption of imported technology to encourage development of national industries. Shanghai is now in the process of solving these problems.

12303
CSO: 4008/369

NATIONAL DEVELOPMENTS

DEVELOPMENT OF INTERDISCIPLINARY SCIENCE WELCOMED

Commentary Hailing Interdisciplinary Science

Beijing GUANGMING RIBAO in Chinese 17 May 85 p 2

[Article by Qian Sanqiang [6929 0005 1730]: "Welcoming the New Era of Interdisciplinary Science"]

[Text] I want to make the two following major points in discussing interdisciplinary science. One is an assessment of contemporary developments in interdisciplinary science; the second concerns China's selection of priorities in developing interdisciplinary science.

Everyone is familiar with the great revolution in modern science which occurred at the turn of the last century. But since midcentury, this revolution has exhibited signs of "saturation," for example, in the areas of nuclear hierarchy research and use of nuclear fission, where subsequent developments have been rather slow.

There are other areas such as controlled thermonuclear reactions and particle physics research where although there have been some new developments and activity has not ceased, still, the pace is off what it was at midcentury. Under these conditions, humanity's vigorous scientific capabilities cannot go unused; thus, there has developed a series of interdisciplinary sciences (peripheral sciences, cross-sciences, and synthetic sciences). It can be predicted that in a certain manner of speaking, the latter part of this century and the beginning of the next one will be an era of interdisciplinary sciences.

In my view, similar to the situation in nuclear physics in the thirties, today's interdisciplinary sciences may be on the verge of a breakthrough. The zones between different natural sciences and between the natural and the social sciences have always been breeding grounds for new fields of study. A whole range of new interdisciplinary sciences should appear by the end of the century. I have read the article entitled "Models for Probing in Scientific Discovery" written collaboratively by Comrades Zhao Hongzhou [6392 4767 1558] and Jiang Guohua [5592 0948 5478]. Their "Level-Grade" chart contains a number

of empty subjects like the empty spots on early periodic tables. It is highly possible that many interdisciplinary sciences will appear in these empty spots, such as sociomathematics, sociochemistry, sociophysics, sociobiology, sociomedicine, sociophyschology, production force economics, scientific sociohistoriography, scientific ability studies, seismosociology, medical sociology, nuclear sociology, nuclear biology, human body science, and science of thought, etc. As this multitude of interdisciplinary sciences springs forth, the great gulf which now exists between the natural and the social sciences will of necessity narrow gradually, culminating in the forceful tide of the march of the natural sciences toward the social sciences foretold by Lenin.

Scientology has a famous basic tenet which amounts to saying that the breakthrough points in science always occur at the crossroads of social necessity and the internal logic of science. What is recounted above refers to the internal logic of scientific development, which is to say that when the vanguard of physics is obstructed, intelligence must shift to another area or else "fall back" to the realm of an older branch of learning. This is what stimulates the appearance of one interdisciplinary science after another. In which case, what is it that society needs? Obviously, what Chinese society needs until the end of the century is what four modernizations require. From the standpoint of interdisciplinary science, the four modernizations, on the one hand, require the development of wide-ranging synthetic branches of learning, such as urban science, marine science, energy science, space science, biotechnological and nutritional science, and agricultural systems engineering science, etc. In another aspect, there is a special need for development of interdisciplinary sciences which relate to strategy, planning, management and leadership of the "four modernizations," such as scientiology, management studies, systems engineering, optimization studies, policymaking sciences, urban sciences, tought-process sciences, logic sciences, and leadership sciences, etc.

Over the past few days, I have been looking through an infulential international journal on the study of science, called SCIENTIFIC ESTIMATE STUDIES. This year, the journal announced that beginning in 1984 it would announce the winner of the Pulaisi [phonetic] [2528 6351 2448] Science Award. The establishment of this award demonstrates the keen attention the world is paying to the development of interdisciplinary sciences. I believe that in a short period of time, even more international awards for interdisciplineary sciences will appear as the new ear for these sciences arrives. It is to be hoped that our scientific workers will make efforts in their exploration, and strive to bring the nation prestige by winning one of these international awards.

Four Modernizations Require Interdisciplinary Sciences

Beijing GUANGMING RIBAO in Chinese 17 May 85 p 2

[Article by Tian Fu [3944 1133]: "Development of Interdisciplinary Sciences Is a Requirement for the Four Modernizations"]

[Text] The world-famous professor of the study of science, Pulaisi [phonetic] proposed a famous law called the law of expotential increase in the development of science. He holds that establishment of this law of expotential increase is a premise for the continuing explosion of new spheres of research and the birth of new branches of learning. History has shown that since the middle of the current century, many new branches of learning have appeared, most of which are interdisciplinary. At the end of last year, of the 34 learned societies newly recognized by the Scientiric and Technical Association of China, some were societies for interdisciplinary sciences. Obviously, the endless appearance of interdisciplinary sciences and their gradual formation into groups of sciences is one major feature of the great age of contemporary science now going on. This is my first point.

Secondly, cross-pollination between the natural and the social sciences is becoming sounder and stronger every day. Science is basically a social phenomenon. Whether they be natural or social, all are sciences which recognize the material world. Marxism tells us that the objective material world is a unified one; and consequently, all sciences are basically part of one corpus. In fact, many of the new questions raised in socialism's four modernizations could never be resolved by relying upon one natural scientist or one social scientist. Environmental questions, for example, ecological, energy, urban construction, and space navigation problems, etc., all need to be handled by natural and social scientists in collaboration and can only be solved through cooperative effort. In the area of resolving the real questions of society as well, the thought and methods of the social sciences and those of the natural sciences are continually permeating and blending with one another. Certain specific concepts common to natural scientists are being adopted and utilized by social scientists every day; likewise, some traditional ideas and viewpoints of social scientists are being borrowed by natural scientists. As one famous Japanese scholar put it, "Natural science can be termed 'the social science of nature'; and social science can be termed the natural science of society." This has some sense to it. Since the middle of this century, the convergence of natural and social sciences has already become an unobstructable historic tide.

Third, I feel that the basic task of China's interdisciplinary sciences right now is to look to society and to the economy and strive to realize the four modernizations by the turn of the century. On the one hand, interdisciplinary sciences have their own positive aspects in dealing with this task; on the other, it will only be if the various

interdisciplinary science societies and the various comrades working in each of these sciences can join hands that this task can be accomplished. As an example, the central leadership of the party has made timely suggestions for "four modernizations" standards for cadres in order that the four modernizations can be realized. I feel that in this great scientific era, one way of characterizing the "four modernizations" of the cadres is as a change in a generation's concept of leadership. This requires a Marxist science of leadership. As Comrade Qian Xuelin [6929 1331 2651] has pointed out in his discussion of the branching structure of fields of learning in scientiology, the scientiology of politics needs to be studied. Later, several middle-aged scientiology workers, echoing Mr Qian's opinion, got together with the broad mass of cadres and set up this new field of learning. Thus, a science of leadership should be incorporated into the category of the scientiology of politics. Obviously, the study of relationships between science and leadership, science and politics, and science and superstructures is going to be an interdisciplinary science which links the natural and the social sciences to one another. If the cadres are to become specialized, then the science of leadership is going to be the specialization which the broad mass of cadres shall study. If the cadres are to become intellectuals, they are going to have to study knowledge of a number of both the natural and the social sciences, including the interdisciplinary ones. In essence, whether the question be one of specialization or one of intellectualization, it cannot be divorced from interdisciplinary science. I suggest that the study and popularization of a science of leadership which is going to change a whole generation's concept of leadership should unquestionably be a task of our interdisciplinary sciences.

Finally, I feel that each of the interdisciplinary sciences will have a place on the map of science, that each one is a science, and consequently that each involves a problem of how it is to be established. A common saying is that roots must run deep for the foliage to be thick. A branch of learning without a certain degree of depth will have difficulty in being of service to the four modernizations. We must all be guided by the basic spirit of two documents of the central leadership, the "Decision Concerning Reform of China's Economic System" and the "Decision Concerning Reform of China's S&T System," and make clear the relationships between upgrading and popularization and between theory and utilization. As far as the many interdisciplinary realms are concerned, research standards in China are no lower than international ones. Some are in the very forefront. It is to be hoped that all will strive further and heroically struggle to bring standards in the realm of China's interdisciplinary sciences up to or above advanced world standards.

12303
CSO: 4008/369

NATIONAL DEVELOPMENTS

FUJIAN, SCIENCE ACADEMY SIGN COOPERATION PACT

OW070537 Fuzhou FUJIAN RIBAO in Chinese 16 Jun 85 p 1

[Text] The provincial people's government and the Academy of Sciences of China signed the long-term scientific and technological cooperation agreement yesterday afternoon at the Xihu Guesthouse in Fuzhou. Governor Hu Ping and Lu Jiaxi, president of the Academy of Sciences of China, signed the agreement.

Zhang Yumin, Gao Hu, You Dexin as well as leaders of the provincial Science and Technology Commission, the provincial Personnel Exchange Service Center, and the Fujian Institute of Material Structure attended the signing ceremony. The agreement, based on the principle of accelerating the transformation of scientific and technological achievements into productive forces and promoting the scientific, technological, and economic progress of our province calls for long-term mutual beneficial cooperation by bringing into play the strong points of the two parties. The Academy of Sciences will provide our province with scientific and technological consultation services and some personnel and help our province in formulating economic, science, and technology plans and in carrying out major research projects. Our province will provide the necessary services and strengthen information exchanges.

The two parties have initialed 29 agreements and contracts in line with the guidelines of the agreement. The academy's institutes of photochemistry, computer, and physics will provide technical assistance to the Xiamen Photosensitive Materials Company in order to build Xiamen into the nation's largest photosensitive materials base. The academy's computer institute, chemistry institute, and Dalian Institute of Chemical Physics will help train personnel and provide all-out support to the construction of the Meizhouwan oil refinery. The academy will also send personnel to help our province in formulating the economic, science, and technology plans for the special economic zone, the development areas, and the open cities and areas. Our province will vigorously cooperate with the academy's personnel and give them economic remuneration and rewards.

CSO: 4008/378

NATIONAL DEVELOPMENTS

72 NEW INVENTIONS WIN STATE S&T AWARDS

OW291358 Beijing XINHUA in English 1322 GMT 29 Jun 85

[Text] Beijing, June 29 (XINHUA)--A high-yield wheat strain and the hand and finger reconstruction surgery technique have won first class national invention awards by the State Science and Technology Commission.

This was announced at the 17th meeting of the commission's recommendation and examination committee, which closed here today.

The new wheat strain "Mianyang No. 11," bred by the Mianyang Prefectural Institute of Agricultural Sciences in Sichuan Province, Southwest China, is suitable for the local climate of high temperatures and moisture, and little sunshine. The short stalk strain is lodging-and-disease-resistant and has good adaptability. The wheat is large and spherical, and 1,000 grains weigh 43 to 45 grams. Its per-hectare yield is 15 to 20 percent more than ordinary strains. It contains 13.62 to 14.13 percent of protein, up to the standards of the world's fine wheat strains.

In 1984, the strain was grown on 1.4 million hectares of farmland, producing an additional yield of 10.5 million tons, 345 million yuan in terms of value.

The hand and finger reconstruction surgery technique, invented by Dr. Yu Zhongjia of the Sixth People's Hospital in Shanghai, reconstructs hands or fingers with transplantation of toes from patients themselves. Since October 1978, the hospital has reconstructed 33 hands for 30 patients, but three hands failed to survive. The reconstructed hands are able to write, manage daily life and lift a weight of three to five kgs.

Thirteen inventions that won second-class awards include a new soyabean strain suitable for growing in cold alpine areas, a technique for raising wild musk deer and musk-extracting, new medicine for malaria and silicosis, a new zsm-5 molecular sieve synthesizing method, a technique for repairing damaged railway rails and a low-alloy and high-intensity steel.

The committee also approved 33 inventions for third-class awards and 24 for fourth-class.

Since China promulgated the regulations for invention awards in late 1978, altogether more than 970 inventions have been awarded.

CSO: 4010/159

NATIONAL DEVELOPMENTS

PRC'S 'SPARK PROGRAM' TO KINDLE RURAL SKILLS

OW081314 Beijing XINHUA in English 1033 GMT 8 Jul 85

[Text] Beijing, July 8 (XINHUA)--The Chinese Science and Technology Commission is putting together a program to develop small and yet effective items of technology applicable to township industries, according to a "Guangming Daily" report.

Yang Jun, the commission's vice-minister, identified the program as "the spark program" to kindle rural technical progress.

The commission will pay attention to high technology and rural technical progress at the same time, Yang stated.

Promotion of technical progress in township and rural industries, and medium-sized and small urban factories should be part of China's strategy for scientific and technical development, Yang said.

This can help change the production structure in the countryside, modernize township and rural industry, and raise social production efficiency, Yang said.

Yang said that technical progress would also help the country tap more fully its natural and human resources, and overcome waste and environmental pollution used by backward technology.

In its efforts to promote commodity production in the rural areas, the commission this year plans to spread advanced techniques for the development of mountainous areas, fish and livestock breeding, farm produce processing and light chemical industry.

The growth rate of the industrial value in the rural areas was 24 percent last year.

More than 52 million peasants now work in factories and mines run by townships in China--about 14 percent of the rural labor force.

CSO: 4010/2008

NATIONAL DEVELOPMENTS

GUIZHOU SCIENCE, TECHNOLOGY WORK MEETING ENDS 8 JULY

HK100825 Guiyang Guizhou Provincial Service in Mandarin 2300 GMT 8 Jul 85

[Excerpts] The provincial conference on science and technology work which lasted 5 days, concluded in the hall of the provincial government yesterday [8 July] afternoon. At the conference, Governor Wang Chaowen put forward the work which should be done in the near future in reforming the science and technology structure.

Leading comrades of the provincial CPC committee and the provincial government attended the conference and spoke. They fully affirmed the achievements made by the science and technology workers in the course of developing science and technology and invigorating Guizhou's economy and extended their lofty respects and sincere thanks to all science and technology workers throughout the province.

Vice Governor Xu Caidong presided over yesterday afternoon's closing ceremony. Wang Chaowen, deputy secretary of the provincial CPC committee and governor, spoke. He pointed out: We are now carrying out reform of the economic, science, technology, and education structure. This reform requires every one of our leading comrades to effect a big change in ideological method, leadership method, and work style. We must particularly shun the malpractice of simply indulging in idle talk but not doing practical work and overcome the evil work style of being dilatory, shifting responsibility onto others, disputing over trifles, and wrangling. We must vigorously, properly, carefully, and constantly solve the practical problems one by one in the course of reform. We must work steadily and make solid progress.

After that, he pointed out that the whole province must handle eight aspects of work in the near future in the reform of the science and technology structure.

1. It is necessary to pass down as soon as possible the decision of our province on vigorously carrying out reform of the science and technology structure. The provincial CPC committee and the provincial government must pass this decision down before August for implementation. Regarding the other six supplementary documents, as soon as one of them is completed, it must be approved and passed down by the provincial government. All of them must be approved and passed down before the end of this year.

2. A provincial science and technology leadership group must be established before September this year.

3. Funds for science and technology must be increased and appropriated and the level of equipment and the ability of scientific research must be raised. The provincial government has decided: in a certain period from 1986, some 5 percent of the local regular revenue will be used as funds for science and technology. In 3 years from 1986, apart from the above-mentioned funds, a certain amount of special funds for scientific and technological apparatuses and equipment will be appropriated from the province's revenue every year. Over the past 2 years, 1 million yuan in funds has been appropriated for scientific and technological development every year. In addition, certain funds will be properly appropriated to make arrangements for scientific research, technological development, and other development projects. The funds for science and technology must be issued to support those good scientific and technological items whose volume of business at the technology fairs inside and outside the province is large.

4. It is essential to make practical progress in reform of the science and technology structure. In the aspect of reform of the system of appropriating funds, in coordination with the scientific research organs and the departments in charge of them, the provincial science and technology committee must define the nature of every one of the 88 independent natural scientific research organs throughout the province, must classify them, and must determine the system of appropriating funds for these institutions. Concerning the technology market, it is imperative to set up a provincial technology market guidance group and a regular provincial technology market.

5. The provincial science and technology committee and departments concerned must be instructed to do well in expanding the powers of the scientific research organs and in conducting a pilot project of implementing the contract system for providing scientific and technological services for remuneration. Apart from the approved units which have launched a pilot project, the provincial chemical industry institute, the provincial machinery institute, the provincial light industry institute, and the Guiyang City scientific research institute are also approved to launch a pilot project.

6. It is imperative to do well in grasping the comprehensive technological development in mountainous areas. Our province has selected four counties, including [word indistinct], Luodian, Yuping, and Puding, as the counties to launch a pilot project of comprehensive technological development in mountainous areas. Departments concerned must do their best to carry out cooperation and must strive to make achievements as soon as possible so as to set an example.

7. Technological assistance must be given to medium-sized and small enterprises throughout the province, particularly to township and town enterprises.

8. It is necessary to formulate regulations governing the management of the transfer of qualified personnel concerned.

Governor Wang Chaowen demanded: CPC committees and governments at all levels must really include reform of the science and technology structure on their agenda, strengthen leadership, and give careful guidance.

CSO: 4008/2016

NATIONAL DEVELOPMENTS

HENAN GOVERNOR ADDRESSES SCIENCE, TECHNOLOGY MEETING

HK101327 Zhengzhou Henan Provincial Service in Mandarin 1400 GMT 9 Jul 85

[Text] Yesterday afternoon, He Zhukang, deputy secretary of the provincial CPC committee and governor, spoke at the provincial meeting on science and technology work. Comrade He Zhukang emphatically explained several problems which should be solved in doing well in the reform of the science and technology structure:

First, it is necessary to strengthen the vitality of the science and technology organs, to reform the system of appropriating funds for the science and technology organs, and to expand the decisionmaking power of the science and technology organs.

Second, it is essential to open the technology markets and to transfer technological achievements to commodities.

Third, it is imperative to strengthen the combination of scientific research and production and to increase enterprises' ability to absorb technology and to carry out exploitation.

Fourth, it is necessary to give full play to the role of science and technology workers.

Comrade He Zhukang also stressed strengthening leadership over the reform of the science and technology structure. He expressed the hope that CPC committees and governments at all levels will attach great importance to this reform, regard reform of the science and technology structure as a strategic measure to invigorate science, technology, and the economy and a major issue of CPC committees and governments at all levels, and grasp this work firmly and well.

CSO: 4008/378

NATIONAL DEVELOPMENTS

HENAN'S YANG XIZONG STRESSES SCIENCE, TECHNOLOGY

HK140507 Zhengzhou Henan Provincial Service in Mandarin 1230 GMT 13 Jul 85

[Summary from poor reception] Provincial CPC Committee Secretary Yang Xizong made a speech at the provincial conference on science and technology which concluded yesterday. Other provincial leaders present included Liu Zhengwei, Zhao Di, Zhang Shude, and Zhang Zhigang.

Yang Xizong's speech was in three parts: "The whole party must attach great importance to science and technology and bring into full play its tremendous role in economic construction. 2) Respect knowledge and talent and bring into full play the role of existing talent. 3) Strengthen leadership over reform of the science and technology structure."

Yang Xizong said: "Knowledge and talent are fundamental for invigorating the economy, accomplishing the four modernizations, and building the two civilizations. The main problems in talent in Henan are, first, there is not enough; second, the existing talent has not been brought into full play. At present we must focus on bringing into full play the role of the province's 350,000 talented science and technology personnel. We must first get a good grasp of further implementing the party's policy on intellectuals." Every talented person must be employed in the job best suited to him.

Yang Xizong stressed that the party and government leadership must do well in leading the reform of the science and technology structure, with a high sense of responsibility and urgency.

CSO: 4008/2016

NATIONAL DEVELOPMENTS

XINJIANG HOLDS SCIENTIFIC, TECHNOLOGICAL CONFERENCE

HK241553 Urumqi Xinjiang Regional Service in Mandarin 1300 GMT 19 Jul 85

[Text] Yesterday afternoon, at the regional scientific and technological work conference, Janabil, secretary of the regional CPC committee, delivered a speech. He stressed that leading organs at all levels must be resolved and do their utmost to properly carry out reform of the scientific and technological system, and to firmly grasp scientific and technological work.

Janabil said that since the founding of the PRC, the region has made rapid development in science and technology. At present, the region has formed a contingent of more than 160,000 natural science and technology personnel. The scientific and technological personnel of various nationalities, under the leadership of the party, have carried forward the revolutionary spirit of dedicating themselves to the border area, worked hard, exerted strenous efforts, and achieved results in nearly 1,000 scientific and technological items, thus making great contributions to the region's scientific and technological development. However, due to various defects of the existing scientific and technological system and the failure to closely combine science and technology with economic construction, it is impossible to give full play to the wisdom and ability of the vast number of scientific and technological personnel. Reforming the science and technology system means breaking with various trammels on scientific and technological personnel, mobilizing thousands upon thousands of people in scientific, technological, and intellectuals circles to take part in the construction for four modernizations, and applying the scientific and technological achievements to the four modernizations, economic construction in particular.

Comrade Janabil stressed that the reform of the science and technology system is a very complicated massive exploration and creation, which concerns the future destiny of the state and the success and failure of the four modernizations. CPC committees and government at all levels must truly attach importance to it and firmly grasp it. They must raise

strict demands on themselves, give meticulous guidance, pay less lip service, do more practical work, encourage and support all localities, departments, and units to explore and experiment with the reform, teach and guide the vast number of scientific and technological personnel to take part in the practice of reform on their own initiative, and make new contributions to invigorating the region's science and technology.

CSO: 4008/2022

NATIONAL DEVELOPMENTS

REGIONAL MEETING ON SCIENCE, TECHNOLOGY, EDUCATION HELD

SK260455 Hohhot Nei Monggol Regional Service in Mandarin 1100 GMT 25 Jul 85

[Text] The regional scientific, technological, and educational work conference sponsored by the regional CPC Committee and government ceremoniously opened in Hohhot on 25 July. The tasks of this conference are to implement the guidelines of the national scientific, technological, and educational work conference, to deeply study the decisions of the CPC Central Committee on the reform of the scientific and technological structures, and on the reform of the educational structure, and to study the important speeches of the central leaders, measures for implementing the two decisions of the CPC Central Committee in line with the actual situation of the region, and ways to conscientiously do a few solid things in the course of carrying out scientific, technological, and educational work.

Leading comrades of the regional party, government, and the CPPCC Committee, including Bu He, Qian Fenyong, Tian Congming, Wu En, Li Xiangyi, Xu Lingren, Ma Zhenduo, Wen Jing, Lin Weiran, Ke Ligeng, Seyinbayaer, Hu Zhongda, Bai Junqing, Zhao Zhihong, Shi Shengrong, and Han Ming, attended the conference.

Kong Fei, member of the Standing Committee of the National CPPCC Committee, (Guo Shuyan), deputy director of the general office of the leading group for scientific and technological work under the State Council, and vice minister of the State Scientific and Technological Commission, and (Yang Zhi), member of the delegation dispatched by the central organ to the region to help train teachers, were invited to the conference.

The opening ceremony was presided over by Tian Congming, deputy secretary of the regional CPC Committee. Bu He, deputy secretary of the regional CPC Committee, and chairman of the regional government, delivered a speech on vigorously reforming the structures of science, technology, and education as well as developing and invigorating scientific, technological, and educational undertakings.

He said: The two decisions of the CPC Central Committee are our guide in the reform of the scientific, technological, and educational structures and our guiding principle for developing and invigorating the socialist scientific, technological, and educational undertakings. Leading comrades at all levels and comrades on the scientific, technological, and educational fronts must integrate the regional reality with the specific experiences and lessons, conscientiously and repeatedly study the decisions of the CPC Central Committee word by word, and unite their ideology and understanding as well as their actions with the guidelines of the decisions and the speeches, and proceed from the reality of the region to study and formulate feasible and specific measures for implementing the two decisions and to do a few good things in order to stimulate the structural reform and the development of science, technology, and education.

In his speech, Bu He pointed out: As long as we persist in proceeding from the reality of the region, conscientiously study and implement the two decisions, give sincere guidance, and work hard, our regional reform of the scientific, technological, and educational structures will develop smoothly and our scientific, technological, and educational undertakings will be more invigorating.

(Guo Shuyan), deputy director of the general office of the leading group for scientific and technological work under the State Council, and vice minister of the State Scientific and Technological Commission, gave a speech and extended warm greetings to the conference. Zhao Zhihong, vice chairman of the regional government, also spoke at the conference.

Attending this conference were leading comrades in charge of scientific, technological, and educational work of the various league and city CPC Committees, administrative offices, and governments, comrades of the relevant regional departments in charge of such work, and responsible persons of scientific research units, and representatives of some banners, counties, plants, mining enterprises and establishments, and various kinds and levels of schools, totaling more than 300 persons.

CSO: 4008/2022

NATIONAL DEVELOPMENTS

BRIEFS

JILIN TECHNOLOGY CONTRACTS--At the first national trade fair for technological achievements, which was held in Beijing, Jilin Province signed some 780 contracts or letters of intent on technology transfers and cooperative operation. Total transactions in the technological trades reached 78 million yuan. [Summary] [Changchun Jilin Provincial Service in Mandarin 1030 GMT 7 Jun 85 SK]

HEILONGJIANG TECHNICAL TRANSACTIONS--Heilongjiang Province fulfilled some 23 million yuan worth of transactions at the Beijing trade fair for technical findings. Of these 56 were contracts regarding technical transfer, involving 6.467 million yuan, while others were contracts for other items, involving 16.575 million yuan. [Summary] [Harbin Heilongjiang Provincial Service in Mandarin 1000 GMT 8 Jun 85 SK]

SCIENCE JOURNAL REPUBLISHED--KEXUE [Science], a large comprehensive journal of natural sciences whose publication was suspended in 1960, will soon be republished in Shanghai. Nie Rongzhen, Fang Yi, Yan Jici, Zhang Aiping, and "Lu Jiaxi wrote inscriptions for the republication of the journal. Professor (Arthur Schuller), renowned physicist and recipient of Nobel Prize in Physics, also sent a congratulatory letter to the journal. Founded in 1915, the journal aims to spread the world's latest scientific knowledge and emphasizes both theory and practice. It played an important role in China's modern and contemporary history of science. Zhou Guangzhao, vice president of the Chinese Academy of Sciences, will be the editor in chief of the republished journal. The first issue will come off the press in September. [Excerpts] [Beijing DOMESTIC Service in Mandarin 1200 GMT 23 Jul 85]

SCIENTIFIC INSTITUTES, LABORATORIES TO OPEN--The Chinese Academy of Sciences will select a group of research institutes and laboratories in branches which occupy a leading scientific position and have prospects for wide application to open to the whole country successively, and to foreign countries if conditions permit. Since the latter half of last year, after prudent selection, the academy has planned to first open 17 laboratories and 2 institutes which have fairly solid foundations, and has conducted appraisals. After the laboratories and institutes are opened, scientific workers within and outside the institutes, or within or outside the country, who are engaged in basic research or in basic work for the application of research may submit their research projects and apply for doing research in the laboratories within a certain scope. [Text] [Beijing City Service in Mandarin 1000 GMT 26 Jun 85]

CSO: 4008/2016

APPLIED SCIENCES

MODULAR PROGRAM STRUCTURE EXPLAINED

Beijing DIANZI KEXUE JISHU [ELECTRONIC SCIENCE AND TECHNOLOGY] in Chinese No 3 [Mar] 84 pp 8-11, 40

[Article by Zheng Hao [6774 3185] and Chen Chuanzhou [7115 0278 3166], Dalian Radio Factory: "Modular Structure and Performance for Domestically Produced Four-Bit Microprocessor Software"]

[Excerpts] Currently, two model series of four-bit microprocessors may be batch produced in China, the DJS-020 and the DG-0040, which creates an advantageous situation for expansion of applications for four-bit microprocessor devices.

The purpose of this paper is to discuss an optimal design method for four-bit microprocessor hardware by analyzing a typical program-- the software for the electronic register produced by the Dalian Radio Factory. This analysis is provided for reference by those engaged in four-bit microprocessor software design.

The electronic register is a business-dedicated computer based on a DG-0040 four-bit microprocessor device chip. This machine does service calculations like pricing, account calculations, collection, discounting, figuring change, etc., according to several (4 to 8) commodity sales categories. Using digital readout, it can print sales receipts and issue tickets. It performs these functions through keyboard input of data and operational commands. The software is a resident program burned into a 2716 EPROM.

Organization of the Modular Program

1. A Comparison of Modular Program Design with Flowchart Program Design

At present, the majority of hand written programs for microcomputers are written according to the flowchart program design method. Although this method has the advantages of being easy to learn and to understand, when tasking is rather large there is no scale or limits for indicating logical relations and lines and arrows of operational sequences, as well as loops, because flowcharts are only unstructured diagrams. Therefore, this invariably makes written programs appear confused, it is easy to make mistakes, and debugging and revision is difficult. With each revision one must erase and rewrite the EPROM, so the amount of work is somewhat onerous.

The modular program design method is to divide the already determined whole software task into a few relatively independent sub-tasks, i.e., modules. The task and function of each individual module is obvious, the logical relations are obvious, and they are easy to write and debug. After communication modes, restraining conditions, and data parameters have been determined, they can be separately written by several program designers, which will improve programming speed. This is difficult to do with the flowchart design method. When there is an error in the program, it is also easier to find the errors and debug them, and after the main modules have been debugged, the other modules can be separately debugged. This might speed up debugging for the entire program.

Input: use the keyboard for entering data and run commands for the various operations. Keyboard input is sent to the accumulator via the K channel of the DG-0040, the program is used for discrimination, as the input signal must maintain at least 16 ms (to eliminate flutter) before it is effective, and is active high. When there is an error in the input operational sequence there is an error indication displayed on the nixie tubes. Keyboard input is made up of signals on the three input lines K_1, K_2, K_3, and the D scan driver. The definition of the keys on the K_2 line will be determined by the state of the K_4 mode lock switch, and the state of the mode switch is changed by keys.

Output: output equipment is an 8-bit Chinese character wheel printer and 8-bit nixie tubes. The G channel signal line of the DG-0040 chip acts as the printer control line, and the DG-0041 provides the segment signals and bit signals needed by the nixie tubes. The printer, nixie tubes, and keyboard all use the D signal as a scan signal.

Data handling: based on the various requirements of calculations, we ought to first write keyboard operation sequences and arithmetic sequences to take care of the various service calculations. Then, from these sequences draw the basic calculations, such as addition, subtraction, multiplication, etc.

Error handling: there are two kinds of errors that can be recognized by the program, one being arithmetic errors, such as overflow and special negative values; the other is errors in keyboard operations. For erroneous operations that create arithmetic errors, an indication is displayed on the nixie tubes. Some operations errors that involve the printer cannot be recovered from, and the system cannot deal with some erroneous operations.

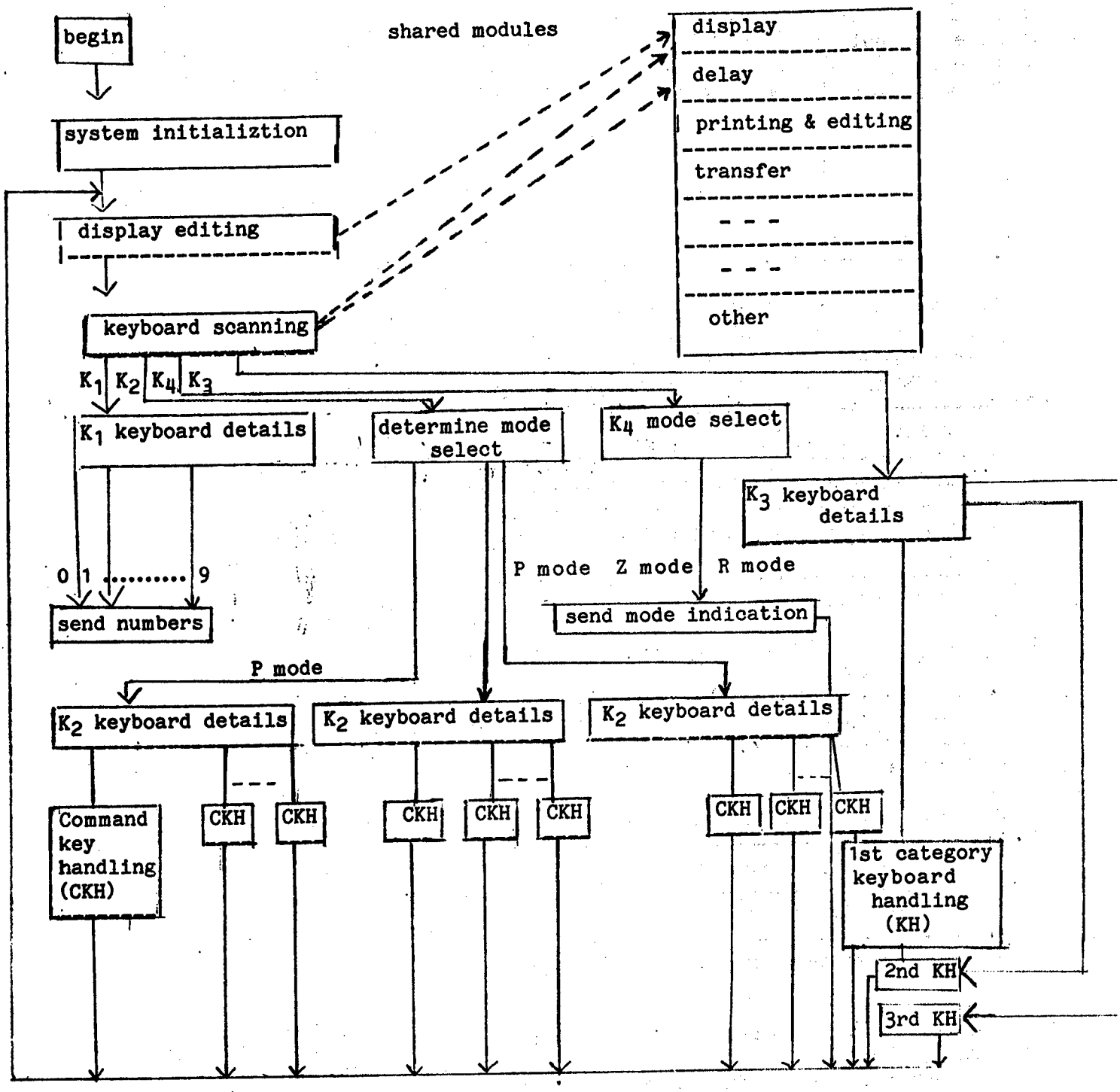
Operator factors: it provides the keyboard to operators as input equipment, and a printer and nixie tubes as output equipment. Operators enter data and commands via the keyboard, the nixie tubes display the data entered, and the printer prints the results of output processing.

3. The Division of Modules

(1) The principles and methods for dividing modules.

Before discussing how to divide up modules, we provide a chart for the modular structure of the electronic register program, for which, see figure 1.

Figure 1. The Modular Structure of the Software for the Electronic Register



4. Allocation of Data Storage

During program design, the general rules when dealing with allocation of data storage is that they be:(1) easy to write and find addresses (2) reduce program length (3) conserve storage, but of course when storage capacity is sufficient conserving storage is not necessary.

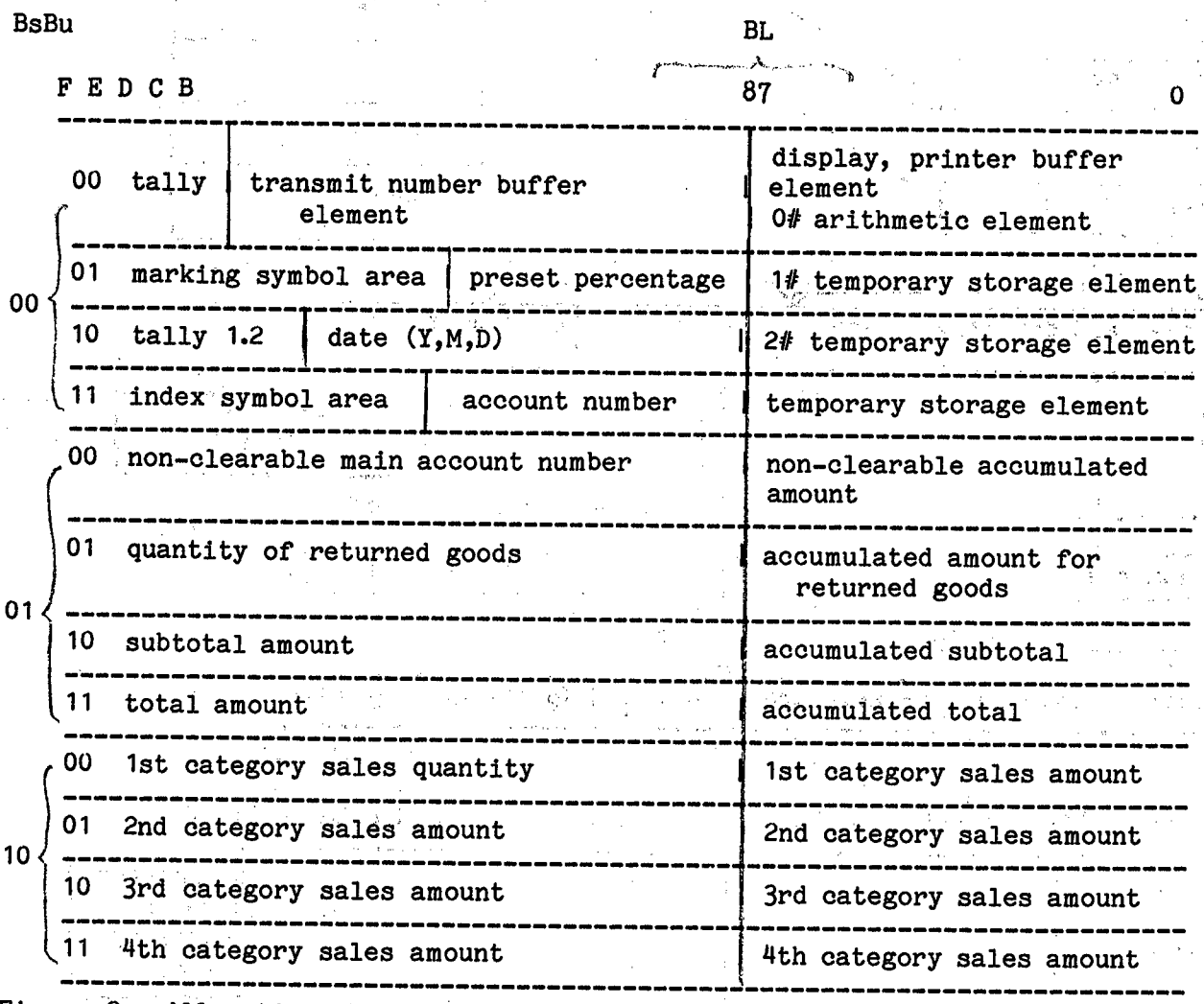


Figure 2. Allocation Chart for Data Storage

The address counter for the DG-0040 chip data storage is 8-bit binary, B_s (2 bit), B_u (2 bit), and B_l (4 bit). The address range is 256 (4-bit binary), and this program goes as far as to partition 32 8-bit hexadecimal elements. The data storage allocation chart is in figure 2.

Module Implementation and Program Debugging

1. Small Flowcharts for Modules

After the design of the modules, they must be edited, where, generally speaking, a flowchart should be set up for each module. The operational process, organizational structures, and results of the program as reflected in the flowcharts must be strictly based upon the module definitions, including limiting conditions, communications stipulations, and various data parameters. As for the electronic register, do top-down editing of the modules, with first the initializing, displaying editing, and keyboard rough principles modules. This will allow the main program to be set up first, after which the K keyboard detailed modules and the various keyboard processing modules that depend upon them can be edited. We give as an example flowcharts for two modules.

(1) Explanation of the display module flowchart

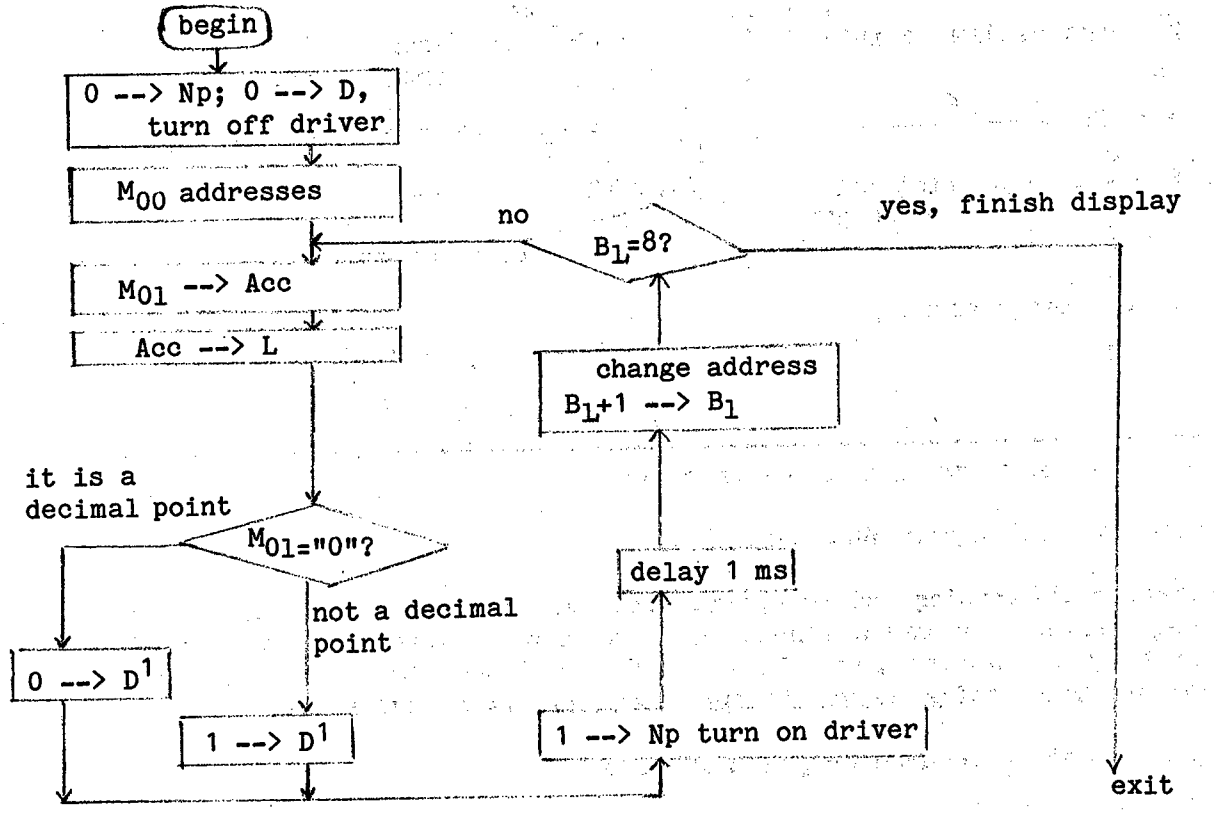


Figure 3. Flowchart for Display Module

We can see from figure 3 that the display begins positional display from the low position, and when it encounters a decimal point, the D signal does not change position, but displays once at the original position. Display time at each bit is 1 ms.

(2) Explanation of the display editing module

As seen in figure 4, it first determines whether or not M^{07} is 0, then determines whether it is the code for the error indicator "E," where if it is not "E" it explains overflow, then moves M^{02} to the decimal point, then sends "E," then sends F to the other bits to close the display of these bits. If M^{07} is 0, then the decimal point is sent to M^{02}, testing again from the high bit, an empty bit sending F to turn off the display, and if it is a simple decimal, adds a 0 before it.

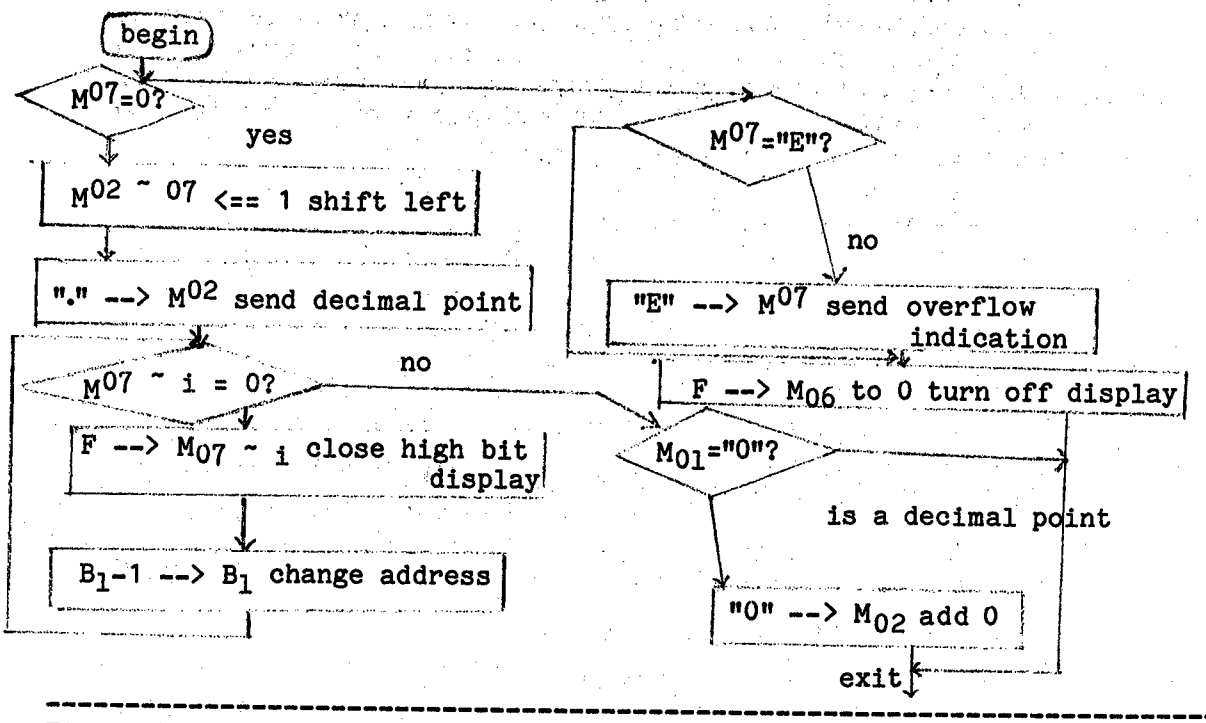


Figure 4. Flowchart for Display Editing Module

2. Optimization of Program Structure

In the process of writing and debugging programs, how does one prohibit cross functioning between the various modules? How can we write programs in which the operating sequences are clear? This can all be solved using the structured program design method to optimize program structures.

The components of structured programs include:

(1) linear sequential structure: that is, each module is executed in sequence, for which see figure 5.

(2) conditional structure: this is a kind of discriminating structure that, when condition A is fulfilled executes B; otherwise it executes C, as in figure 6.

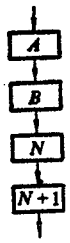


Fig. 5

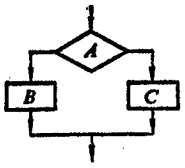


Fig. 6

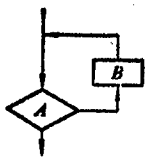


Fig. 7

(3) linked structure: when logical relations satisfy condition A then execute B, and keep on until condition A is negated, as in figure 7.

(4) selected structure: this is a connected discriminating structure, often used in keyboard scanning, as in figure 8.

We ought to point out that structured programming design cannot be used with all modules, nor need all modules make use of structured programming. We can see from the modular structure chart for the electronic register that structural optimization is overall.

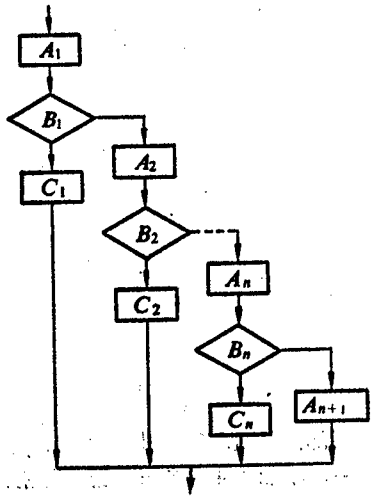


Fig. 8

3. Finding errors in programs

Finding errors is an important link in program debugging. When debugging tools are lacking we can use manual inspection methods to find errors. They include the following points:

(1) Comparisons between instruction codes and the instructions, and between instructions and the flowcharts.

(2) See whether the beginning of the cycle and the concluding state are appropriate. Ensure that within the cycle relevant registers and memory elements each have accurate parameters.

(3) Check for conditional jump, and if jumps occur under two conditions, then ensure that selection and definition are the same.

Errors commonly found during inspection are:

(1) Did not set an initial value in the accumulator and index flip-flop, etc.

(2) The logical relation for a conditional jump is reversed.

(3) There was a change in the accumulator contents at a data storage address during addressing.

(4) In the program operational sequence, revision of the contents of the tally element and index element was not accurate.

(5) Data and register contents occasionally change.

(6) When the state index ought to have changed, it has not.

12586
CSO: 4008/227

APPLIED SCIENCES

LASER ACTIVE COLOR CENTERS STUDIED

Shanghai ZHONGGUO JIGUANG /CHINESE JOURNAL OF LASERS/ in Chinese Vol 12, No 1 20 Jan 85 pp 15-19

/Article by You Lu /1429 6424/, Li Ping /2621 1627/, Li Shenghua /2621 0524 5478/, Fang Shugan /2455 2579 3227/ of the Department of Applied Physics, Shanghai Jiaotong University and Wei Shouzhu /7614 1343 2691/, He Shaoqi /0149 4801 0366/ and Wang Kuihua /3769 7608 5478/ of Zigong Institute of Chemical Engineering, Sichuan: "Laser Active Color Center F_B(II) in KCl:Na Crystals"/

/Text/ Abstract: By using an additive coloration method, an F-center concentration of 10^{-16} to 10^{-18} cm^{-3} in KCl:Na crystals is obtained. The F_B(II) centers are formed by exposing the additive colored crystal to the F-band excitation, and the emission band of the color centers covers the range of 2.1 to 2.8 μm, with a peak at 2.5 μm.

I. Introduction

In 1974, Ollenauer and coworkers of the Bell Laboratory first developed an infrared continuously tunable color center laser. Color center lasers and color center crystals have since received great attention because they possess the unique advantages of being continuously tunable in the infrared region, and having a low threshold and a narrow linewidth. They have important applications in molecular spectroscopy, optical communication, and frequency standard. Recently commercial color cneter lasers with a 1-year guarnatee have become available, indicating more important developments in this area.

This article describes our work of obtaining F_B(II) color centers in KCl:Na crystals. Included in this report are the method for botaining high concentration pure F centers at high temperature, the measurement and calculation of the F center concentration, the F $\rightarrow$ F_B(II) conversion at low temperature, the absorption spectra of the converted crystals at room temperature and at 77K, and the fluorescent excitation and emission of F_B(II) at 77K.

II. Principles

1. Laser active color center $F_B(II)$ in KCl:Na

Fig 1 shows the structure of some color center in KCl:Na. As shown in Fig 2, the F center is a four-level system but the intensity of the F center emision is very low (f$\sim$0.01) and since the F centers are susceptible to bleaching, they are not suitable as laser active color centers.

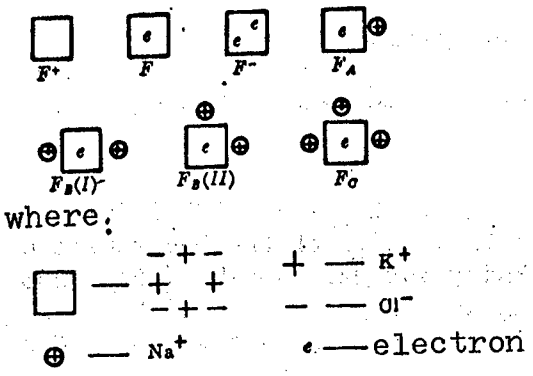


Fig. 1. Schematic structure diagram of color centers in KCl:Na crystal

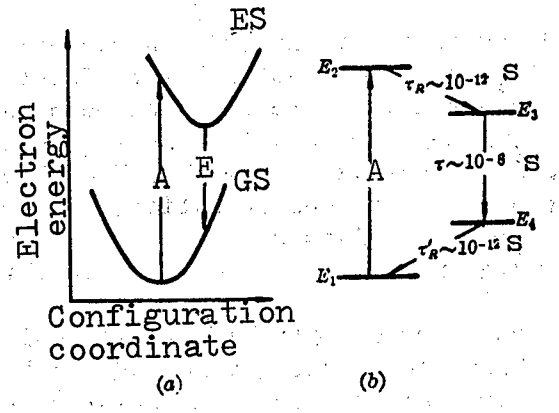


Fig. 2. Electron transition of the F center
(a) F center electron energy as a function of configuration coordinate
(b) The four energy levels of the F center electron

A-- Absorption E--Emission
ES--Excited state GS--Ground state

$F_B(II)$ is also a four-level system, but it has two impurity positive ions Na^+ in the x and z directions. The symmetry is reduced to C_{2V} and the p state is split. Since the perturbations of the Na^+ ion on the p_x and p_z states are equal and greater than the perturbation on p_y, the p_x and p_z states remain degenerate and have an energy lower than that of p_y. When the electron makes a transition from the ground state to the p state, two absorption bands $F_{B1}(II)$ and $F_{B2}(II)$ appear in the absorption spectrum, as shown in Fig 3a. The structure of the relaxation excited state (RES) of the $F_B(II)$ center is similar to that of H_2^+, the emission intensity is large and the electron motion is strongly coupled to the lattice vibration. The emission spectrum is broad and $F_B(II)$ is therefore an appropriate color center for tunable lasers.

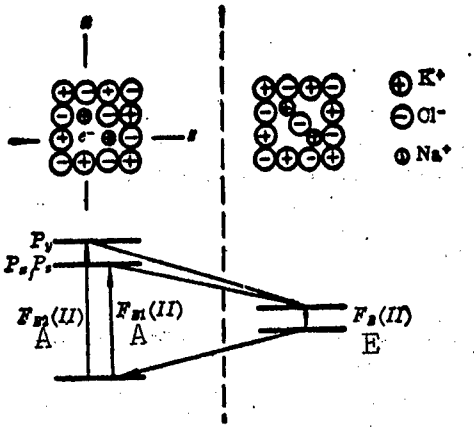


Fig. 3. Ion configuration and the corresponding energy level diagram of $F_B(II)$ color centers in KCl:Na. Left-- normal configuration, right-- relaxed configuration.
A-- Absorption E--Emission

2. Formation of the $F_B(II)$ color centers

(1) Generation of the F center

Using an additive coloration method, the KCl:Na crystal is heated in a potassium atmosphere at an elevated temperature. The K^+ ions adhere to the crystal surface and diffuse into the crystal. The crystal has large number of Schottky vacancies, some of the K^+ ions diffused into the crystal will occupy the cation vacancies. The anion vacancies may capture an electron and become F centers. In addition, the Cl^- ions on the regular crystal lattice may acquire sufficient energy at high temperature, become unbound ions, diffuse to the surface and combine with the excessive K^+ ions to form new lattice layers. The remaining anion vacancies may also combine with electrons and form color centers.

The concentration n_F of the F cneters in a crystal is directly proportional to the area under the absorption spectral curve. The relationship is given by the Smakula formula:

$$n_F f = 1.29\times10^{17}\frac{n}{(n^2+2)^2}\alpha_{max}W$$

where f is the strength of the F center oscillator, n is the refractive index of the crystal at the absorption wavelength, α_{max} is the peak absorption coefficient, and W is the half width of the absorption peak. For KCl:Na crystals, the equation above is simplied to

$$n_F f = 1.08\times10^{16}\alpha_{max}W$$

and f may be taken[6] to be 0.81.

(2) Conversion from F center to F_B(II) center

When the additively colored KCl:Na crystal is illuminated by light in the F band, some of the F centers are ionized and form F^+ and electron. The electron may combine with another F center (F centers carry a weak positive charge) and form F^- center. This process may be written as:

$$2F+h\nu_F \longrightarrow F^+ + F^-$$

In a KCl:Na crystal, F^+ is mobile at temperatures above -50°C. When the F^+ center migrates to the vicinity of two Na^+ with opposing ⟨110⟩ direction and captures an electron, a F_B(II) center is formed. Therefore, F_A and F_B(I) centers are always present when a F_B(II) center is formed. The absorption bands of these types of centers overlap with the F center absorption band, but the Stokes shift of the F_B(II) center is much greater than that of F_A and F_B(I); as a result, the presence of F_B(II) centers is easily deteced from the fluorescence spectrum.

III. Experiment

Fig 4 shows the additive coloration apparatus. Experimentally the KCl:Na crystal and a suitable amount of potassium are first placed in the heating tube. The tube is pumped out and filled with a suitable amount of inert gas such as argon. The tube is then placed in a furnace already heated to a predetermined temperature and the furnace automatically maintains the diffusion temperature once it is reached. After a predetermined period of diffusion has elapsed, the tube is taken out and quickly cooled. The experimental temperature and diffusion time depend on the F center concentration and crystal size desired. In one run on a 0.5mm thick KCl:Na crystal, the diffusion temperature was 620°C, the time waS 40min, and the pressure of the argon gas was 60 torr.

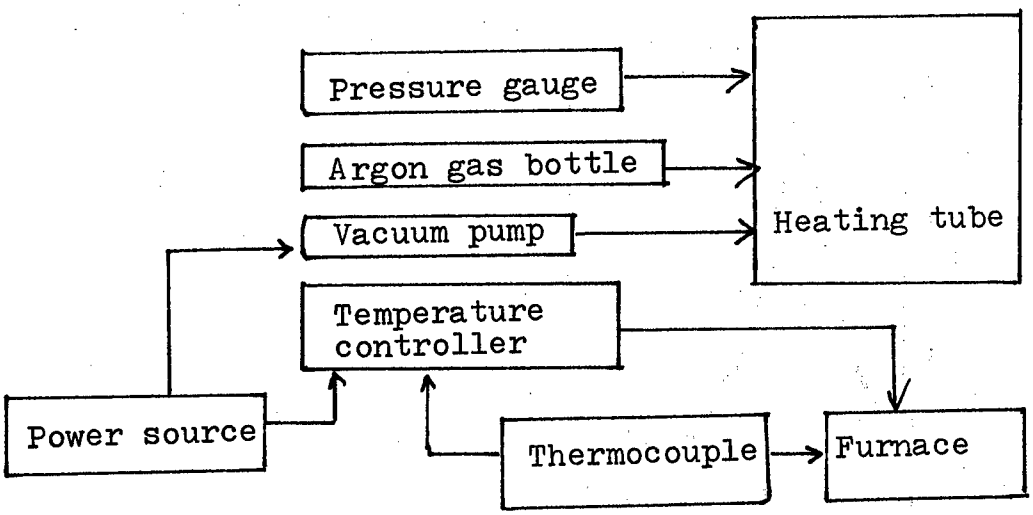


Fig 4. Block diagram of additive coloration apparatus

The colored crystal is then sectioned and a spectrophotometer is used to measure its room temperature absorption spectrum, see Fig 5. From the figure, we obtained* a peak absorption coefficient $_{max}$ of 57.3cm^{-1} and a half width W of 0.448eV. Using the Smakula formula and taking f to be 0.81, we compute the concentration of the F center and obtained n_F:3.5x10^{17}cm^{-3}.

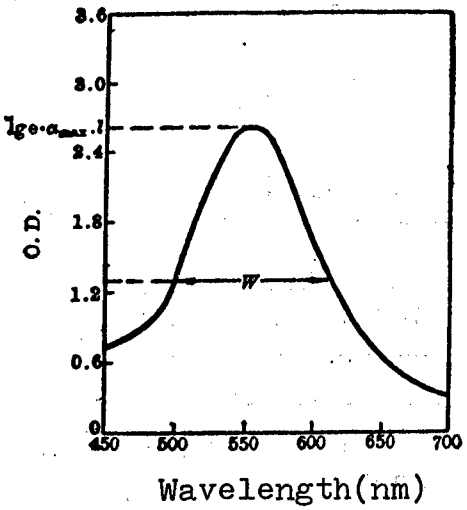


Fig 5. Room temperature absorption spectrum of an additively colored KCl:Na crystal. The crystal thickness is 1.04 mm and the coloration conditions are given in the text.

Fig 6 shows the absorption spectra of rapidly cooled and naturally cooled crystals. Fig 7 shows the color center conversion apparatus. In the conversion process the crystal is placed in a constant temperature sample chamber and the temperature is controlled in the -78°C and room temperature range by a mixture of dry ice and alcohol in a dewar. The temperature is measured and displayed using a thermocouple and a digital voltmeter. The F band light from a mercury lamp converts the F centers into F_BII centers. A typical data set for a KCl:Na crystal contains the following information: F center concentration before the conversion n_f = 3.5x10^{17} cm^{-3}, Na content = 1200ppm, LI content less than 2ppm, conversion source: 200W mercury lamp, temperature T = 35°C, time t = 50 minutes.

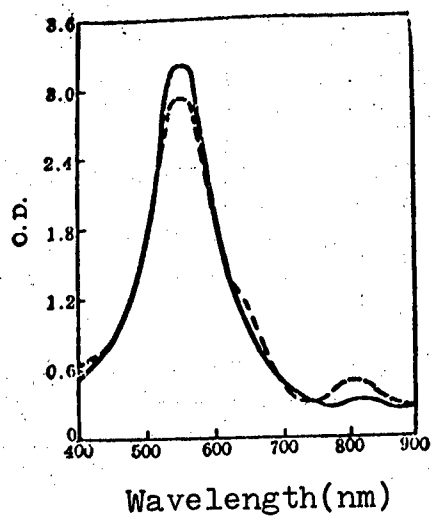


Fig 6. Absorption spectra at room temperature of rapidly cooled (———) and naturally cooled (------) colored crystal

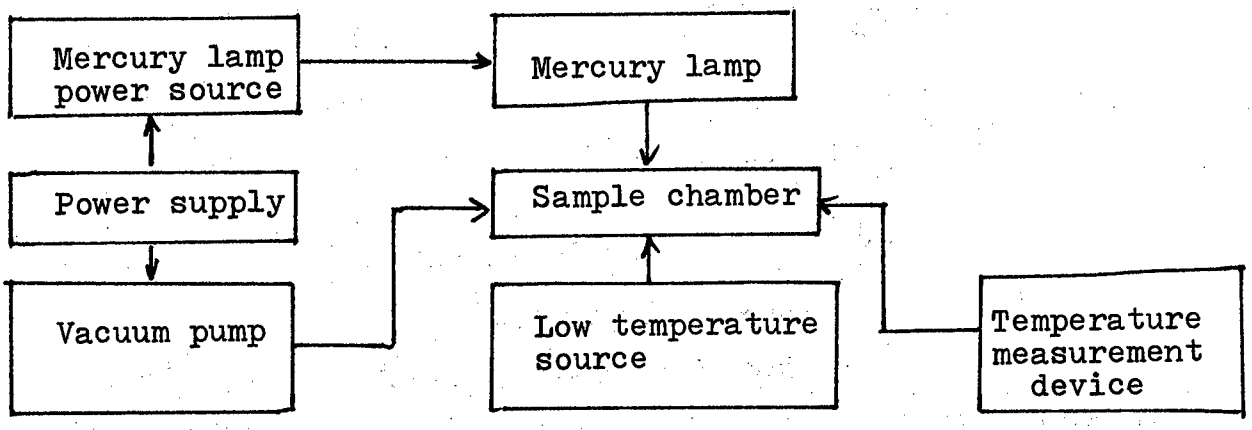


Fig 7. Block diagram of the color center conversion apparatus

Figs 8-11 show the room temperature absorption spectrum, the liquid nitrogen temperature absorption spectrum, the liquid nitrogen temperature fluorescent stimulation spectrum and emission spectrum of a converted crystal.

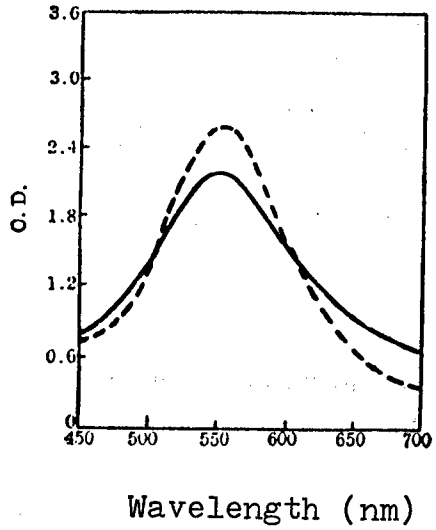


Fig 8. Room temperature absorption spectra of the crystal before (----) and after (——) the conversion. See text for the conversion conditions.

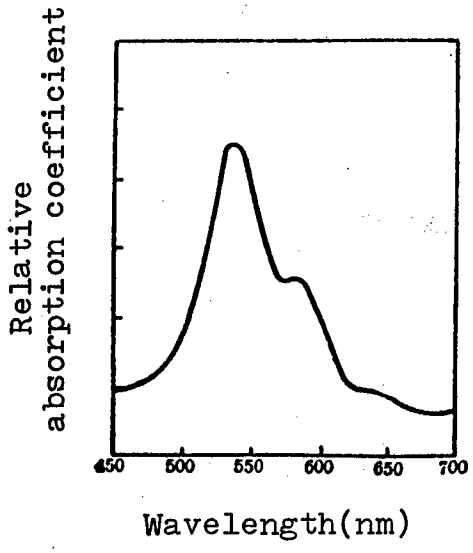


Fig 9. Liquid nitrogen temperature absorption spectrum of the converted crystal

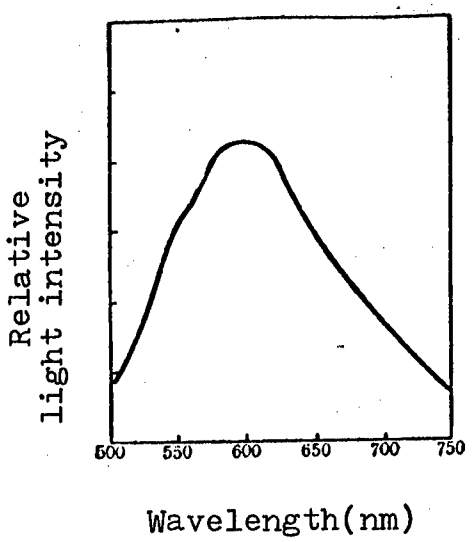


Fig 10. Fluorescent stimulation spectrum of the F_B(II) color centers in KCl:Na at nitrogen temperature (λ = 2.5 m)

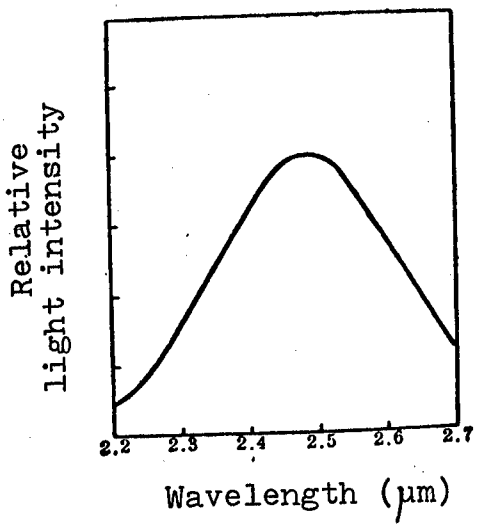


Fig 11. Fluorescence spectrum of F_B(II) centers in KCl:Na at liquid nitrogen temperature. (Excitation wavelength = 580nm)

IV. Discussion

1. As shown in Fig 6, the rapid cooling method can freeze the F centers already formed and effectively suppress the F_2 centers with an absorption peak near 810nm. This favors the F F_B(II) conversion.

2. Fig 8 shows that conversion broadens the width of the absorption band and lowers the peak value; that is, the number of F center decreases in the conversion process and other centers appear. At the liquid nitrogen temperature the absorption band shows three absorption peaks at 535, 580, and 635nm. This indicates the generation of F_A, F_B(I) and F_C centers during the conversion process. The 535nm peak is a superposition of the F_{B2}(II) peak at 516nm, the F_{A2} peak at 530nm, the F_{B2}(I) peak at 514nm, the F_{C2} peak at 530nm, and the F peak at 540nm. The 580nm peak is a superposition of the F_{B1}(II) peak at 580nm and the F_{A1} peak at 585nm. The 635nm peak is the sum of the F_{B2}*U(oeaj at 636nm and the F_{C1} peak at 620nm.

3. The fluorescence excitation peak shown in Fig 10 occurs at 580nm or so--basically consistent with the F_B(II) absorption peak. Howemer, Fig 10 does not show any pronounced F_{B1}(II) and F_{B2}(II) double peak structure and we believe that this peak is caused by the wide slit of the monochrometer in the fluorescence spectrometer.

4. The liquid nitrogen temprature fluorescence emission band (580nm excitation) of the F_B(II) centers covers a range of 2.1 to 2.8 μm and the peak is at 2.5 μm. This is consistent with the results reported in Bibliography references 1 and 2.

The authors acknowledge the contributions of Professor Huang Muzheng /7806 2606 6297/ of Jiaotong University on the 77 K absorption spectra.

BIBLIOGRAPHY

1. L. F. Mollenauer et al, J. APPL PHYS., Vol 46, 3109 (1975).

2. L. Litfin et al, APPL. PHYS. LETT., Vol 31, 381 (1977).

3. K. P. Koch et al, OPT LETTER, Vol 4, 387 (1979).

4. Nishimaki et al, J. PHYS. SOC. JAPAN, Vol 33, 424 (1972).

5. I. Schneider, PHYS. REV., Vol 177, 1324 (1969).

6. C. Z. Van Doorn, Philips Res. Rept. Suppl. 4, 1962.

9698
CSO: 8111/1082

APPLIED SCIENCES

CHANGCHENG 0520 MICROCOMPUTER DESCRIBED

Beijing DIANZI JISHU YINGYONG [APPLICATION OF ELECTRONIC TECHNIQUE] in Chinese No 1, 25 Jan 85 pp 12-14

[Article by the China Computer Technology Service Company: "Briefing on the Changcheng 0520 Microcomputer"]

[Text] The Changcheng 0520 is an eighties level 16-bit microcomputer which China developed drawing on the experience of foreign advanced technology. Its development and batch production marks the entry of China's microcomputer technology into a new stage.

The Changcheng 0520 is compatible with the internationally popular IBM PC/XT and with a view to our specific national circumstances, some performance norms have been revised and improved, especially the CC-DOS Chinese character operating system it uses and the Chinese character processing software under its support. Thus, once the Changcheng 0520 was born it was welcomed and cherished by users.

The China Computer Technology Service Company and its 32 branch companies distributed throughout the country were honored to take on the task of sales and technical service for the Changcheng 0520 microcomputer and in line with our business policy of user first, reputation first, service first and quality first, our company will provide users from technical consultation, training, installation and maintenance to overall technical service for application systems and applications system development so that users will get an assured and useable microcomputer system and can use the computer as quickly as possible to play its role in their own work.

The Changcheng 0520A uses the Intel 8088 16-bit microprocessor and is compatible with the IBM PC/XT. The system has 2 320KB floppy disks, 1 10MB hard disk and 512KB of onboard memory. The difference from the IBM PC/XT is that the main board also has two serial ports and one parallel port, thus the Changcheng 0520's performance is even more improved.

0520A Hardware Configuration

The Changcheng 0520's exterior configuration is similar to the IBM PC/XT. The disk drives are on the right hand system of the system cabinet. The

thinking behind the positioning of the computer's power switch was that it should be in the hardest place to touch--therefore it was placed on the back of the system cabinet. On the back of the system cabinet there is also a warm start switch whose function is the same as the simultaneous use of the Alternate, Control and Delete keys used by the IBM PC/XT and other compatible computers for a warm start. With a warm start switch, when the system must be restarted or when it has deadlocked for some reason, by lightly pressing this switch, the system restarts and it is not necessary to turn off the power support and execute a cold start, thus saving tens of seconds of time.

Basic configuration of the Changcheng 0520A system:

1. 0520A system unit, one
   8088 CPU, 4.77 MHz
   256KB RAM
   one parallel interface (connected to printer)
   two RS-232C serial interfaces
   two 5 1/4" 320KB floppy disk drives and controller
   one 5 1/4" 10MB (or 18MB) hard disk drive and controller
   one color graphics monitor interface board
   keyboard, power supply, cabinet, fan, five slots

2. one 256KB RAM expansion board

3. one 12" color graphics monitor

4. one TH-3070 24 pin printer and cable

5. one DOS 2.0 GWBASIC and other materials

Processor

The Changcheng 0520A and the IBM PC/XT both use the Intel 8088 as microprocessor with a clock frequency of 4.77 MHz. The registers in the 8088 are all 16-bit. The system address bus has 20 bits. An Intel 8087 copressor (a floating point processor) can be added to the Changcheng 0520A, which can improve operating speed by 15-100-fold.

Memory

The size of the Changcheng 0520A's internal memory can be preselected through a badong [2149 0520] switch on the system board. Usually, the 0520A's memory is set at 512 KB. During cold starts a program automatically checks the size of the memory.

Display

The Changcheng 0520A can use two different monitors: one is a high density monochrome and the other is a color monitor. The maximum screen display is 80 x 25 characters. In addition to normal characters there are reverse characters, subscripts and high intensity characters. The monochrome monitor's

display resolution is 720 columns x 300 lines. The color monitor display resolution is 640 columns x 200 lines, permitting color graphics display and Chinese character display and at the same time has 16 colors.

Keyboard

Like the IBM PC/XT, the Changcheng 0520A has a total of 83 keys. It has an area of 10 function keys and an area for number keys and cursor control keys. The keyboard itself has a microprocessor and character buffer area. In addition, there are certain improvements, such as indicator lights for the caps and number keys. The caps key and carriage return key both are in the position they usually appear on the keyboard so that it is easy for the user to adapt to keying habits.

Floppy Disk Drive

The 0520 A has two 5 1/4" floppy disk drives, each with a capacity of 320 KB. They use direct drive and are very fast. During read/write operations, the magnetic head touches the disk surface reducing magnetic head loss and prolonging useful life.

Hard Disk Drive

The 0520A has one 5-1/4-inch hard disk on the right hand side of the system cabinet. The hard disk capacity is 10MB, access speed is very fast, generally 10-fold faster than the floppy disk. If the user has to, another hard disk can also be added.

Interface Devices

The Changcheng 0520A's parallel and serial interfaces are in the back of the system cabinet. Usually, the parallel interface is used as a parallel printer interface which can be connected to any parallel printer. The two serial interfaces are programmable. The serial interfaces use the RS-232C communications standard, their transmission rate is 50-9600 baud, can handle effective word length of 5,6,7 or 8-bit binary, and termination bit of 1, 1-1/2 and 2 bits. The serial interface can be connected to a serial printer as well as to a serial communications terminal. In the 0520A's BIOS software there is a terminal communications control program which the user can use to link terminals.

Expansion Card Slots

The Changcheng 0520A has five expansion slots, the same as the IBM PC/XT. Any board compatible with the IBM PC/XT can be plugged into the expansion slots. Since the 0520A parallel and serial interfaces are on the system board, relatively speaking, it has more expansion slots than the IBM PC/XT.

Power Supply

The Changcheng 0520A's standard power supply is 100 watts. The actual power supply is 200 watts of power. Thus when functions are expanded, it is not necessary to be concerned about the power supply.

Expansion

The Changcheng 0520A itself already supplies many devices which can satisfy most users. However, because in many situations users have special demands and feel that the main system's devices are not enough. For this reason, the Changcheng 0520A has expansion slots. Thus the system has even greater expandability.

The most commonly used expansion boards are disk drive controllers, and memory expansion boards. Others, such as EPROM translators, I/O boards, and AD/DA converters are provided for special users.

The Changcheng 0520A's Advanced Chinese Character System

The Changcheng computer is equipped with an advanced Chinese character system. It includes a complete Chinese character operating system which contains the necessary support software and a great deal of applications software is currently under development. This opens broad prospects for automation of Chinese language information processing.

The Changcheng computer both preserves the computer's original Western language processing functions and also added the Chinese character system. The Chinese character operating system is of modular design, thus it permits the system to be configured and expanded flexibly, i.e., on the foundation of the basic configuration, systems of different sizes can be created on the basis of changes in actual needs. It has many standard interfaces, uses national standard Chinese character code as the exchange code so that mating of the basic computer with external computers or other devices is very simple and convenient.

Presently, a great deal of Chinese character software has been successfully used on the Changcheng computer. After the CCDOS 1.10 Chinese character operating system it uses came out, CCDOS 2.00 and 2.10 came out in succession. This CCDOS has a high degree of compatibility, and is completely compatible with the PCDOS used on the IBM PC. CCDOS supports completely the software in the PCDOS software package. And to satisfy the needs of IBM PC/XT users, we recently put out CCDOS suited for use with the XT. CCDOS also supports the assembly language, BASIC, COBOL, FORTRAN, PASCAL, etc. supported by the original PCDOS and the software and software packages that are written in these languages so there is no need for any revision for them to process Chinese characters directly.

CCDOS functions are extremely powerful. It has seven highly developed Chinese character coding input methods: international code, zone bit code, telegraphic code, first and last stroke code, phonological buxing [6752 1748] code, pinyin

code, and five stroke code. In CCDOS 2.0 a "word troup" fast input method has been developed for the user so that the user can store the word groups he commonly uses in a character library thus greatly speeding up Chinese character keyboard input and making things convenient for the user. Enough Chinese characters are supplied in the character library for the user to select and use in a large space is reserved for the characters created by the user to satisfy the needs of different users. The level I character library contains 3,755 commonly used Chinese characters, as well as some graphs and symbols. CCDOS can for 16 dot matrix or 24 dot matrix Chinese characters and can be matched to a 9, 16 or 24 pin graphics printer to print out Chinese characters of many styles and sizes.

The Changcheng computer will provide the user with a steady stream of Chinese language software. The CdBASE II Chinese language system database management system has already come out and is being used in China by many agencies, organizations and enterprise units. Its flexibility of operation, ease of mastery, and completeness of functions have been discovered in use, information can be exchanged between it and the system of other applications software, thus it will play an enormous role in office automation.

CdBASE II has about 50 commands to allow the user to define and revise the data base structure, input data, search and edit the database, and maintain the database, etc. From this it can be seen that the functions of the newly developed CdBASE II far exceed dBASE II.

In Europe, the United States and some developed countries and regions, Wordstar has now entered every management office and at present the Changcheng 0520A's Chinese character processing software C-Wordstar has already come out and is becoming a capable assistant in routine office processing.

Currently, we are completing CC-CP/M-86, a Chinese character operating system compatible with the CP/M-86 operating system. Chinese language software is being developed for the currently popular spreadsheets SuperCalc III, Multiplan, VisiCalc, and Lotus 1-2-3.

Abundant Software Resources for the Changcheng 0520A

The Changcheng 0520A computer not only has advanced Chinese character software, but is highly compatible with the IBM PC. The overwhelming majority of software which can be run on the IBM PC can be run on the Changcheng computer.

The BASIC program used on the Changcheng 0520A is GWBASIC. It has full screen editing and thus it is easy to revise and edit programs. GWBASIC's functions are powerful: it has graphics functions, sound functions, and interface control commands. GWBASIC has four kinds of variables: intergers (±32767), character strings (up to 256 characters), single precision floating point numbers (7 places) and double precision floating point numbers (16 places). It also has IN and OUT commands which can directly access 64K I/O port.

Operating Systems:
PC-DOS 1.10, 2.0, 2.1
CP/M-86 1.2
Cocurrent CP/M
UCSD P-System
QNX
OASIS-16 6.3A1
(In addition to Chinese character operating system CCDOS 1.0, 2.0)

Languages:

MACRO Assembler
BASIC Language
BASIC Compiler
CBASIC Compiler
C Language
C Compiler
PL/I-86 Language
Level II COBOL
CIS COBOL
RM COBOL
Pascal
Pascal MT+
Pascal Compiler
PC/FORTH
PC/FORTH+
PC/FORTH 2.0 Extension
FORTH CROSS Compiler
FORTRAN 77

Databases:
dBASE II 2.3, 2.4
dBASE Window 3026
dBPLUS 1.1
dNAMES
dGRAPH
dUTIL
Quickcode Program Generator
Data Fax
CONDOR III
Informix database for UNIX and C programmer's tool 3.11
Informix C-isan file access method written in C
R:BASE Series 4000 1.01
FRIDAY
(and Chinese character C-dBASE II)

Spreadsheets and other software:
Multiplan
SuperCalc III
VisiCalc
VisiSchedule

[continued]

VisiFile
Visi Trend/Plot
Stretch Calc
GRAFOX
ABSTAT
Bottom Line V
Versa Form
PFS:File
PFS:Report
Content MBA
Lotus 1-2-3
Inventory Control 8
Wordstar Spellstar Mailmerger Starindex
Easyspell and Easymail
Easy Writer II
Superwriter
General Accounting
General Ledger
The Home Accountant Plus
Assembler Plus Tools
Access Manager
Display Manager
Supersoft: The Optimizer
IBM Omninet
LAN: Data Store
LAN: Data Core
Move it
Async Communication Support
NWA Startpact

8226
CSO: 4008/1032

APPLIED SCIENCES

11 GHz MEDIUM STABLE GaAs-FET OSCILLATOR DESCRIBED

Beijing DIANZI JISHU YINGYONG [APPLICATION OF ELECTRONIC TECHNIQUE] in Chinese
No 1, 25 Jan 85 pp 27-30

[Article by Xi Tianmin [1153 1131 2404], state-run Tianjin Radio Plant:
"11 GHz Medium Stable GaAs-FET Oscillator"]

[Text] Introduction

This paper introduces a stabilized medium stable 11 GHz GaAs-FET oscillator. In the past, it was microwave bulk effect diodes or avalanche diodes that were used mostly as the active component in K wave segment low power solid state oscillators. However, because the bulk effect oscillators are low in power and the avalanche oscillators are noisy, it was felt that there were some inadequacies in using them as local oscillators in receivers. However, using a GaAs MESFET as the active component in an 11 GHz oscillator and using a stabilized medium harmonic oscillator to stabilize the frequency basically satisfies the receiver demands on the local oscillator. However, limited to the performance and materials of medium harmonic oscillators and the performance of GaAs-FET which are currently produced in China, the electrical performance indicators for this oscillator are still not very ideal.

I. Theoretical Basis

1. Oscillation Theory

According to discussions of transistor two kou [0656] network characteristics, the conditions for producing network oscillation are: the relationship of the transistor's input impedance (Zin) and source impedance (Zs) or the transistor's output impedance (Zout) with the load impedance are:

$$Zin(\omega_0)+Zs(\omega_0)=0$$
$$Zout(\omega_0)+Z_f(\omega_0)=0$$

Using the admittance characterization

$$Yin(\omega_0)+Ys(\omega_0)=0$$
$$Yout(\omega_0)+Y_f(\omega_0)=0$$

The physical significance is that in the oscillation frequency, the total impedance of the input circuit is zero (condition for amplitude stabilization), total impedance is zero (condition for phase stabilization); total impedance of output circuit is zero (determines the output power of the oscillator), total impedance is zero (decides the resonance frequency of the oscillator). The above two groups of equalities are equivalent.

The equivalent networks of the transistor oscillator are illustrated in Figure 1.

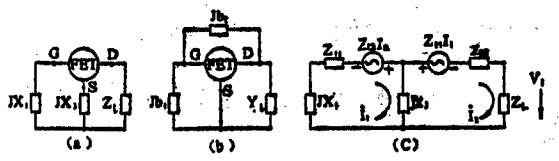


Figure 1

In the figure,

(a) and (b) are dual networks, (c) and (a) are equivalent circuits;
$jx_1 \cdot jb_1$ are source reactance and source susceptance;
$jx_3 \cdot jb_2$ are feedback reactance and feedback susceptance;
$Z_1 \cdot Y_1$ are load impedance and load admittance.

According to Kexihefu's [0344 1585 5440 1133] law, the equation for finding the voltage of two circuits is:

$$[Z_{11}+j(x_1+x_3)]I_1-(Z_{12}+jx_3)I_2=0$$
$$(Z_{21}-jx_3)I_1+(Z_{22}+jx_3)I_2=V_2$$

eliminating i_1 from the above equation,

$$Z_{out}=\frac{V_2}{I_2}=(Z_{22}+jx_3)+\frac{(Z_{12}+jx_3)(Z_{21}-jx_3)}{Z_{11}+j(x_1+x_3)}$$

Z_{11}, Z_{22}, Z_{12}, and Z_{21} in the above equation are the Z parameters of the FET. The S parameters of the microwave FET are easily measured. The small signal S parameters of a GaAs-MESFET are illustrated in Figure 2.

The Z parameters and S parameters have the following relationships:

$$Z_{11}=\frac{(1+S_{11})(1-S_{22})+S_{12}S_{21}}{(1-S_{11})(1-S_{22})-S_{12}S_{21}}$$

$$Z_{12}=\frac{2S_{12}}{(1-S_{11})(1-S_{22})-S_{12}S_{21}}$$

$$Z_{21}=\frac{2S_{21}}{(1-S_{11})(1-S_{22})-S_{12}S_{21}}$$

$$Z_{22}=\frac{(1+S_{22})(1-S_{11})+S_{12}S_{21}}{(1-S_{11})(1-S_{22})-S_{12}S_{21}}$$

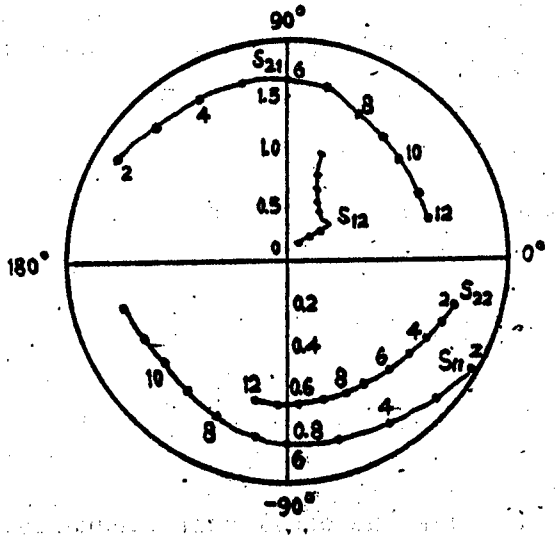


Figure 2

The Z parameters can be found by substituting in the above equations the S parameters measured at a certain frequency; Zout can be computed by substituting the Z parameters and the corresponding x_1 and x_3; the harmonic frequency and output power can be found under a given load Z_1. As the values of x_1 and x_3 change, Zout has a group of curves and using a computer the isograms of the real part Re and the imaginary part Im of the output impedance of a transistor at 10GHz can be computed. See Figure 3(a) and (b). Re as negative value is the necessary condition for starting oscillation; the maximum negative value of Re corresponds to a maximum oscillation state and at this time there is a group of x_1 and x_3 values. Under different frequencies, x_1, x_3 corresponding to maximum negative value of Re achieve optimum combination. The optimum combination of an FET is illustrated in Figure 4(a). The optimum output Zout with changes in frequency is illustrated in Figure 4(b).

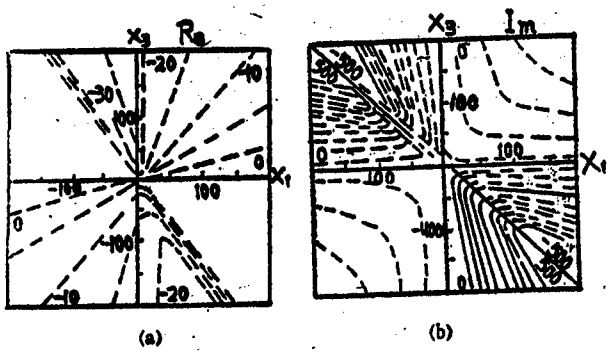


Figure 3

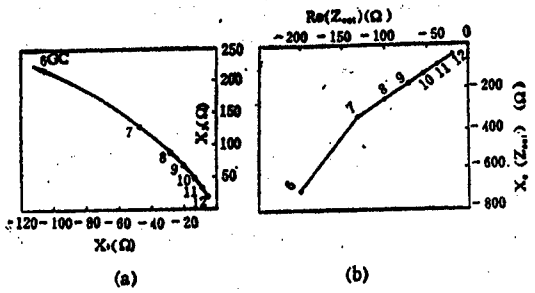


Figure 4

The oscillator can be designed with the above two sets of curves. It must be explained that the above is based on the small signal S parameters which is the condition for the oscillator to begin oscillating. As the amplitude of

the radio frequency leakage increases, the Zout parameter can diminish a single value, until finally it reaches the amplitude balance, therefore Zout is an asymptotic condition.

2. Frequency Stabilization Theory

The oscillator's frequency is decided by the equation:

$$\varphi z_{out} + \varphi z_1 = 0$$

φZ_{out} is the phase of the output impedance; φZ_1 is the phase of the load impedance.

Because the parameters of the active components and passive components which make up the oscillator change as the power supply and environmental conditions change, changes will occur in φZ_{out} and changes will also occur in the oscillator's frequency. To stabilize the oscillator frequency, on the one hand it is necessary to change the components and elements so that the value of φZ_{out} will receive the minimum impact of the environment and the power supply and on the other hand we adopt a medium harmonic oscillator to make φZ_{out} change in the opposite direction and achieve a function as a frequency stabilizer.

Medium frequency stabilization principles:

When a medium harmonic oscillator is oscillating at $TE_{11}\delta$ mode, it can be viewed as a magnetic dipole. A sealed conductance ring can be used for equivalency, and present the parallel harmonic characteristics (see Figure 5). The value of equivalent capacitance C and inductance L are determined from the A,B, ℓ, and medium dielectric constant ε of the oscillator. A, B, and ε mainly influence the resonance frequency, ℓ influences the ratio of C and ℓ. The oscillator's resonance frequency is also related to the environment in which the medium oscillator is situated. For example, in three-layer structure resonance circuits in common use (Figure 6) the resonance frequency is related to d_2 and d_1. The larger d_2 and d_1, the lower the resonance frequency, the smaller d_2 and d_1, the higher the resonance frequency. When a medium oscillator is placed close to a weidaixian [1792 1601 4848], magnetic coupling takes place between the two. Coupling between the medium oscillator and the weidaixian can be viewed as mutual inductance coupling, the impedance it reflects to the weidaixian can be viewed as a series circuit, see Figure 7. In the figure,

$$Z' = \frac{\omega^2 M^2 r_2}{r_2^2 + x_2^2} - j\frac{\omega^2 M^2 x_2}{r_2^2 + x_2^2}$$

$$\varphi' = -\mathrm{tg}^{-1}\frac{2Q\Delta f}{f_0} \approx \frac{2Q\Delta f}{f_0}$$

r_2 is the loss resistance of the medium oscillator;
x_2 is the impedance of the medium oscillator;
M is the inductance coupling coefficient;
φ' is the reflection impedance phase angle.

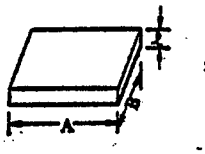


Figure 5

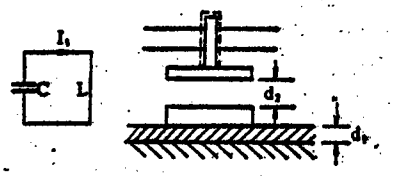


Figure 6

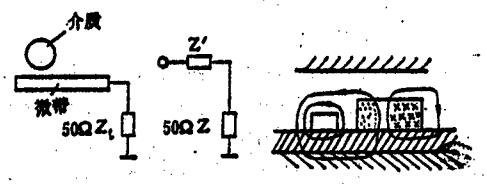


Figure 7

When the secondary resonance $x_2 = 0$, the reflection impedance is the pure impedance $\frac{\omega^2 M^2}{r_2}$, and absorbs the resonance power.

When the working frequency is lower than the medium resonance frequency, the secondary resistance is inductance, and the reflection resistance is capacitance.

When the working frequency is higher than the medium resonance, the secondary resistance is capacitance and the reflection resistance is inductance.

According to the principle of oscillator phase balance stability,

$$\varphi z_{out} = -\varphi z_1 \qquad d\varphi z_1/d\omega < 0$$

Because Zout is tolerance at 11 GHz, the reflection impedance should be inductance, therefore the oscillation frequency must be higher than the resonance frequency. At this time, the derivative of the reflection phase angle $d\varphi z_1/d\omega < 0$, satisfies the stabilization conditions.

Because a high Q medium oscillator was adopted, near φZ_1 the resonance frequency's rate of change is higher.

Generally, the resonance chip is placed $\lambda/2$ from the oscillator's leakage pole, thus keeping the phase relationship from changing. Changing the distance between the medium oscillator and the weidaixian, i.e., changing the coupling, can take into consideration oscillator frequency stabilization and output power.

II. Circuit Design

1. Computations

This oscillator uses the circuit in the form illustrated in Figure 1(a), with a CX51 FET. Because the gain of this transistor at 12 GHz is only 5-7 dB, the maximum resonance frequency is <20 GHz, thus it is designed by maximum power output. First we measured the CX51's S parameters at 11 GHz, and converted them to Z parameters, computing Zout at different values for x_1 and x_3, and determined the optimum x_1 and x_3 values and Zout at this time.

The above complex operations were carried out on a computer and the results were as follows:

$x_1 = -j15\Omega$ $x_3 = j35\Omega$ Zout = -24-j48

When designing load resistance, we took into consideration the fact that Zout was converted from the S parameters measured under small signal, and that the value of Rout should decrease as the resonance amplitude increases, so we took $R_1 = \frac{1}{3}|\text{Rout}|$, $Z_1 = 8+j48$ (R_1 is the real part of the load resistance).

2. Circuit Implementation

The circuit uses as a base plate a 1 mm thick piece of teflon coated on both sides with copper, the characteristic impedance of the load weidaixian was 50Ω the load resistance was 50Ω, the series gate capacitance C was 0.1Pf.

The numerical values of the circuit parts was as follows:

$Z_1 = 50\Omega$	$Q_1 = 73°$	$\ell_1 = 376$ mm
$Z_3 = 40\Omega$	$Q_3 = 41°$	$\ell_3 = 2.11$ mm
$Z_2 = 50\Omega$	$Q_2 = 112°$	$\ell_2 = 5.76$ mm

Z_1, Z_2, and Z_3 are the characteristic impedances of weidaixian ℓ_1, ℓ_2, and ℓ_3 in Figure 8. Taking into account that the medium oscillator is to be added, ℓ_2 is taken as $\ell_2 + \lambda/2g = 15$ mm.

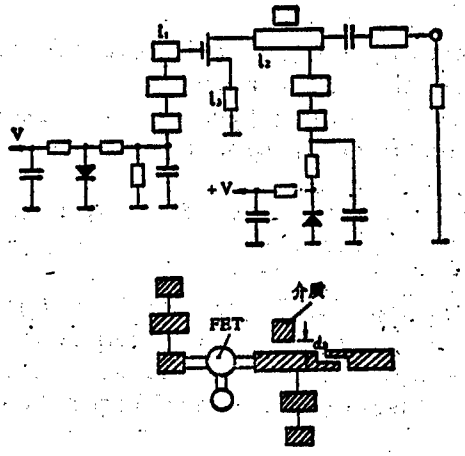


Figure 8

A_s porcelain was used as the medium oscillator, A = B = 4.55 mm, ℓ = 25 mm.

The medium oscillator's resonance frequency was 10.558 GHz.

The actual circuit is illustrated in Figure 8.

III. Microwave Characteristics of the Oscillator

1. The Oscillator Before Addition of the Medium Oscillator Stabilized Frequency

The influence of the gate source voltage and the leakage source voltage on the resonance frequency was large, the push frequency coefficient reached 56 MHz/V, and the natural frequency shift was very large. See Figure 9.

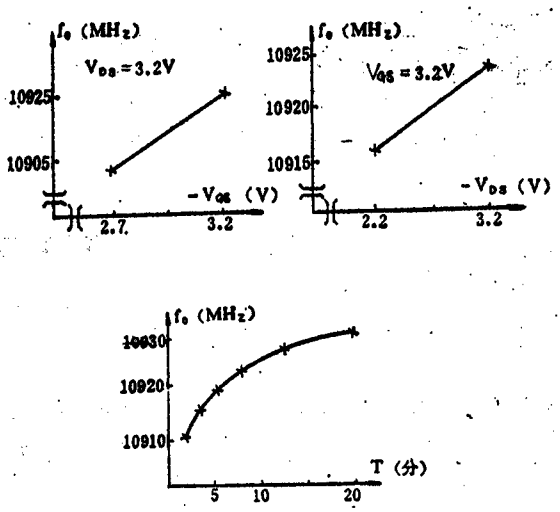


Figure 9

2. The Oscillator After Addition of the Medium Oscillator Stabilized Frequency

The push frequency coefficient improved greatly, $\Delta f/\Delta V_{as}$ reached 8 MHz/V, $\Delta f/\Delta V_{DS} < 1$ mHz/V.

The natural frequency shift greatly improved, see Figures 10(a), (b) and (c).

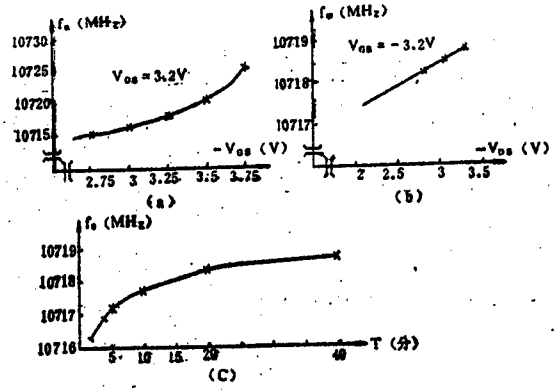


Figure 10

3. Relationship of Medium Oscillator Dimensions and Resonance Frequency

When the medium oscillator's dimensions are large, the difference of the resonance frequency and actual oscillating frequence is larger than the difference of the resonance frequence and the actual oscillating frequency when the medium oscillator's dimensions are small, see Figure 11. This is because the distance between the medium oscillator's dimensions and the three-layer structure has a proportional relationship to the wavelength, and is related to Zout with changes in frequency.

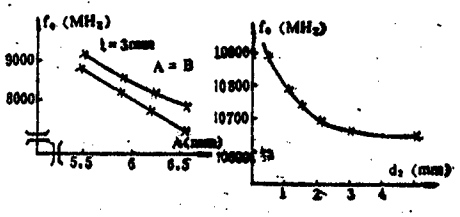


Figure 11

Figure 12

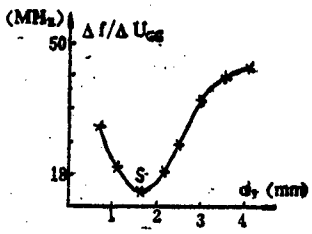


Figure 13

4. Trimming the Oscillator Frequency

A tuning screw can be used to tune the oscillator frequency and change the distance d_2 of the three layer structure. The relationship of oscillating frequency and d_3 is illustrated in Figure 12.

5. Temperature Characteristics of the Oscillator and Output Power

When the laboratory temperature was 20°-50°C, the temperature coefficient reached 9PPM/°C, and output power was 8-10 mW.

6. Influence of Distance Between Medium Oscillator and Weidaixian on Microwave Characteristics

The distance between the medium oscillator and the weidaixian had a big influence on microwave characteristics.

When the distance between the two is small, the oscillating frequency drops, the push frequency coefficient increases, and sometimes the oscillations stop. When the distance between the two is big, the oscillating frequency increases, the push frequency coefficient diminishes, and output power increases. When the distance between the two is very great, the frequency stabilization role is lost. Therefore there is an optimal position d_3, see point S in Figure 13. The optimal position also is related to the medium oscillator's noload Q and ε.

IV. Several Considerations

1. FET can be used for microwave oscillators.

2. Because a highly stabilized medium oscillator was used, when performance is similar, it can simplify the oscillator structure, and therefore greatly reduce costs and facilitate its use in commercial products for civilian use.

3. Frequency stabilization of microwave medium stabilized frequency FET oscillators is currently not as good as medium stabilized frequency bulk effect oscillators (see Figure 14) and even less so than waveguide stabilized frequency bulk effect oscillators. Thus it is necessary to strive for further improvements in FET and medium oscillators.

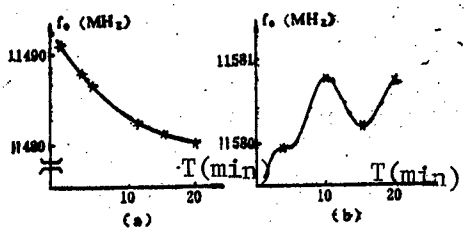


Figure 14

(a) Bulk effect oscillator before addition of medium stabilized frequency
(b) Bulk effect oscillator with medium stabilized frequency

4. In the actual circuit, because the value ℓ_3 was small, being only 2.11 mm, the base plate thickness was only 1 mm, therefore ℓ_3 was very hard to generate. A 0.5 mm thick base plate of teflon should be used.

8226
CSO: 4008/1032

APPLIED SCIENCES

INR 30MeV SECTOR FOCUSED CYCLOTRON DETAILED

Shanghai HE JISHU [NUCLEAR TECHNIQUES] in Chinese No 2, Apr 85 pp 19-21

[Article by Chang Hongjun [1603 1347 6874] of the Shanghai Institute of Nuclear Research, Chinese Academy of Sciences: "INR 30MeV Sector Focused Cyclotron"]

[Text] Keywords: AVF cyclotron, RF system, central region extraction system

The original 1.2m cyclotron at the Shanghai Institute of Nuclear Research was a classical fixed energy cyclotron and the performance parameters in 1964 when the cyclotron was built were:

Energy:	6.8MeV for p	Energy spread:	$\Delta E/E$ = 1 to 1.5 percent
	13.6MeV for d		
	27.2MeV for α	Outer beam:	50μA

To improve the performance of the cyclotron for nuclear physics research and nuclear technology experimentation, a modification proposal was drafted in 1978 to change the cyclotron into a sector focused variable energy cyclotron. After physical design, simulation experiments, technical design, and engineering preparation, the machine was shut down in the summer of 1982 and a beam was obtained in 1983 on schedule. After the modification, the energy constant becomes K = 40, protons may be accelerated to 30MeV and tunable in the 10-30MeV range. In addition, H_2^+ ions may be accelerated at triple frequency to obtain 2-2.5MeV and 6-9MeV protons. The energy may be changed in 2 hours.

I. Basic Design Considerations and Characteristics

1. Major specifications and technical implementation

Since the modifications were made on the basis of the original design, the determination of the technical specifications, the selection of the major parameters, and the structural design were made based on an overall consideration of the technical, economic and practical factors. Efforts were made to use advanced technology and to achieve the best economic results and the shortest construction period. Based on the philosophy above and the requirements of nuclear physics and nuclear technology research at the Shanghai Institute of Nuclear Research, and taking into account the consideration of using the advanced technology available in China and abroad, the major performance parameters were determined to be:

Energy:	10-30MeV for p 10-16MeV for d 20-32MeV for α	Energy spread:	ΔE/E = 0.8-0.6 percent
		Outbeam:	20-50 μA

The major technical approaches were: (1) Replace the original 1.2m conical magnet with a 1.44m cylindrical magnet, install sectors, nine sets of coaxial coils and three sets of harmonic coils per valley. (2) Employ a single 180°D box supported by two internal posts in parallel and a balanced transfer to convert the high frequency push-pull power output into a single arm output (3) Employ two sections of electrostatic deflector plates and install focusing magnetic channels, magnetic shield channel and steering magnets. The two-dimensional layout of the main frame is illustrated in Figure 1.

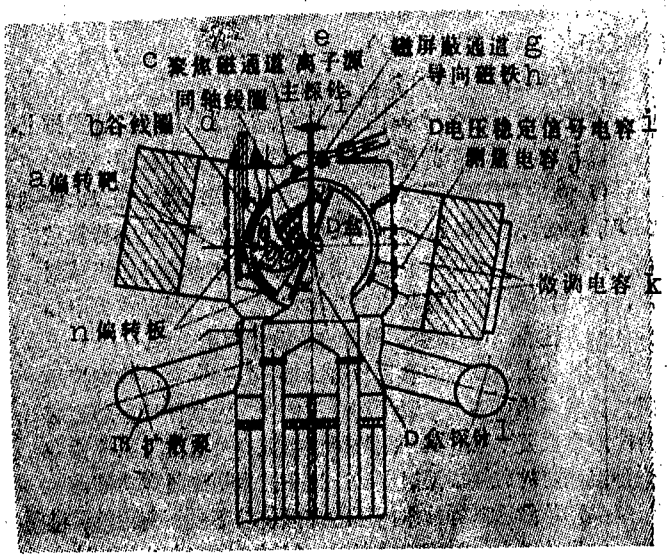


Figure 1. Two-dimensional Layout of the Cyclotron Main Frame

Key:

a. Deflection target
b. Valley coil
c. Focusing magnet channel
d. Coaxial coil
e. Ion source
f. Main probe
g. Magnetic shield channel
h. Guiding magnet
i. D voltage stabilizing capacitor
j. Measurement capacitor
k. Fine tune capacitor
l. D box probe
m. Diffusion pump
n. Deflecting plate

2. Magnet design

To accelerate the protons to an energy of 30MeV using the original magnet of the cyclotron, the field strength should be 15.6kG and the corresponding RF frequency should be 23MHz. The RF generator has an upper limit of 16MHz in the original design and may be adjusted to 21MHz, still short of the 23MHz required. Based on the economic and technical considerations we decided to replace the original 1.2m conical magnet with a 1.44m cylindrical magnet and thereby reduce the magnetic field strength. The RF frequency required became

20.5MHz and the original RF generator can therefore be used. In addition, there are two more advantages: the edge effect of the magnet poles is improved and the extraction of the beam is easier. After increasing the pole area, the original 15mm adjustable air gap is eliminated to prevent further reduction in the field strength.

For optimum field profile, we adopted the constant B pole face to minimize the difference in edge gradient at different field strength and to facilitate the extraction of the beam at different energy. In order to synchronize the field, we selected the appropriate blades and, in addition, we also designed nine sets of coaxial coils for field compensation and to make optimum use of the pole face space. Moreover, using a harmonic coil design, we also connected the three corresponding valley coil into a Y shape and obtained sine-cosine modulated three phase power supply with only the first harmonic and without affecting the average field. The coaxial coils and the harmonic-coils are all made from magnesium oxide insulated copper tubing, the coaxial coils are fixed on the trough cover plate using a vacuum welding technique. The blades and the vacuum chamber cover are made of DT-4 pure ion.

The major parameters of the magnetic field design are as follows:

Vacuum chamber cover diameter:	1,386 mm
Cover gap:	224 mm
Number of fan shaped blades:	3
Blade gap:	146 mm
Angle of helix of blade:	$\gamma < 45°$
Coaxial coils:	9 sets, power stability $1x10^{-4}$
Harmonic coils:	3 sets/valley, power stability $1x10^{-3}$
Mean field strength:	15 kGs, power stability $5x10^{-5}$

Figures 2 and 3 show the magnet pole and the coaxial coil.

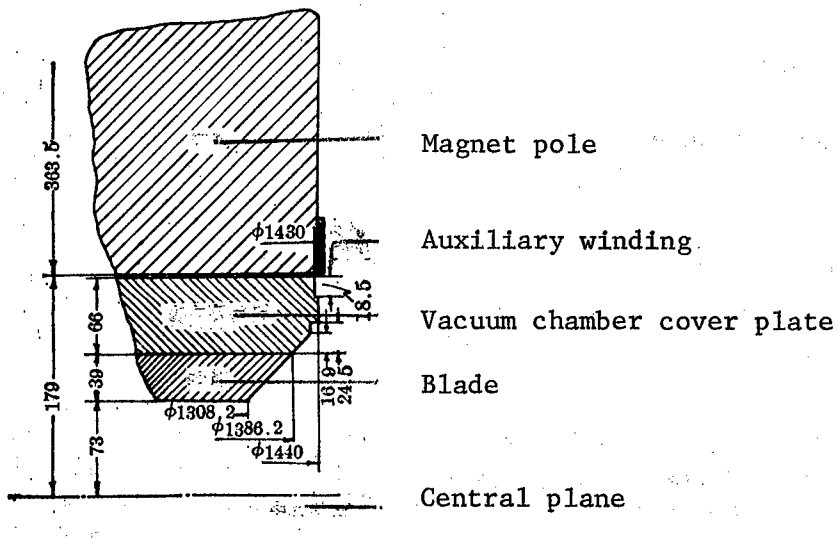


Figure 2. Schematic Diagram of the Magnet Pole

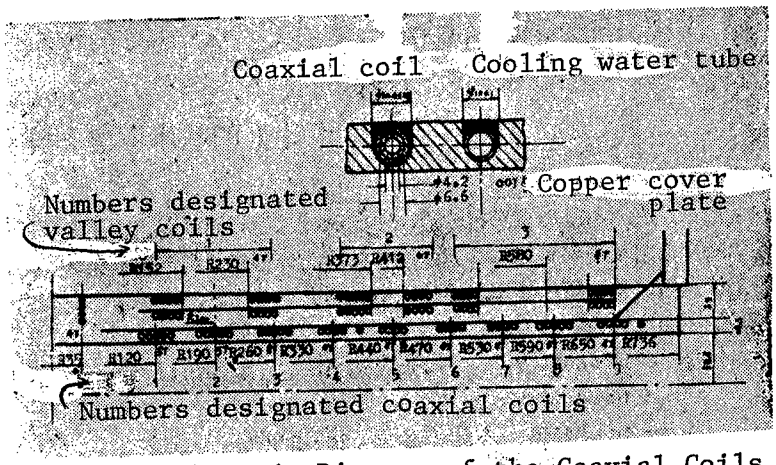


Figure 3. Schematic Diagram of the Coaxial Coils

After compensation, the field synchronization deviation is less than ±5 Gs (in the energy ranges of 10-30MeV for p, 10-16MeV for d and 20-32MeV for α). Before compensation the first harmonic is less than 5 Gs and after compensation the first harmonic is less than 2 Gs.

3. Design of the RF system

The new design of the accelerating system uses a single 180°D box. The tilted D box, making an angle of 20° with respect to the ion source, is supported by two inner posts. This design has six advantages: (1) It satisfies the high frequency requirements and the D circuit can be operated in the 10.5-22 MHz range; (2) The short circuit sheet current density is reduced by a factor of 2. At V_D = 75 kV and f = 21.5 MHz, the current density is 58 A/cm; (3) It leaves sufficient space for the deflecting plates and the original beam movement layout can be used; (4) The mechanical rigidity of the D box is improved and the water lines in the two inner posts may be used to cool the D box; (5) The focusing of the central region is improved; and (6) The voltage asymmetry of the D box is reduced.

The disadvantage is that the adjustment of the D is difficult. This problem is solved by making the touch wire adjustable in two dimensions. In addition, the insulator supports are placed at the ends of the inner posts so that the position of the D remains unchanged when the short circuit plate is moved. The design proved to be successful.

The technical problem encountered in the single D design is that the RF generator must have a single arm output. To modify the RF generator would be costly and time consuming. After comparing a number of plans, we decided to install a balanced transformer with an impedance ratio of 1:1 between the two feeders of the RF generator and the single D. At a frequency of 20.5 MHz, the new setup successfully delivered 100 kW of power. The high frequency power is coupled to the D through coupling capacitors installed on the sidewall of the neck tube.

Figure 4 shows the RF system and the system has the following design parameters:

D box	1 x 180°
Height of D box	48 mm
Beam gap	30 mm
Gap between D and ground	34.5 mm
Frequency range	10.5-20.5 MHz

(The lower frequency may be lowered to 8.5 MHz by installing a 500 pF vacuum capacitor on each of the inner posts)

Power	100 kW

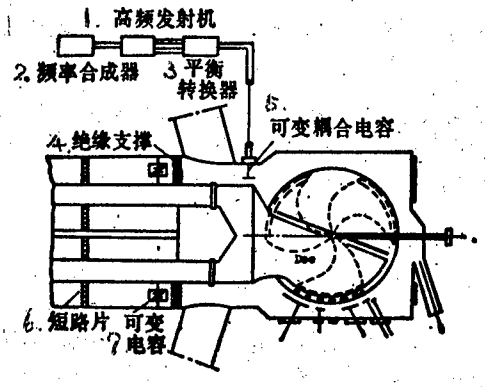


Figure 4. Schematic Diagram of the High Frequency System

4. Central region and beam extraction

The stability of the particle motion and the beam quality of a cyclotron depend largely on the operation of the central region. To insure the stability in the axial motion, we designed a circular plate with a coil for the central region to increase the magnetic field at the central region by 1-2 percent and to form a conically decreasing field. In addition, we placed the D at 20° with respect to the window of the ion source so that the particles travel an extra 20° of path during the first semicircle of their motion.

To insure stability in the radial motion in the central region, the first harmonic of the central magnetic field should be as small as possible. This is achieved by the compensation of the harmonic coils in the central region. The harmonic coil should be placed at the geometric center of the D and it may also be used to center the particle beam.

In the deflection and extraction system, the deflecting plate consists of two sections and may be adjusted remotely in the radial direction. This design facilitates the extraction of particles of different energy. The first section consists of flat plates with a subtended angle of 50°, the entry is 5 mm and the exit is 8 mm. The second section is hyperbolic with a subtended angle of 52°, an entry of 8 mm and an exit of 16 mm. The entry of the deflection plate is located near $\nu_r = 0.8$ (R = 620 mm). The extraction is in the precession mode and the spacing of the particle orbit before extraction is

increased by the precession of the first harmonic when the particle passes through $\nu_r = 1$. For the convenience of dismantling, the deflection plates are installed on the same base which can be pushed in or pulled out by a cart.

To reduce the radial divergence of the beam after exiting from the deflection plates, a focusing channel is installed. It consists of three iron blocks and provides a quasi-lens gradient.

To make sure that the extracted beam enters the original beam transport tube at the proper deflection angle, we must also reduce the fringe field. Without using coils, we designed a magnetic shield channel using a double layer material that has a high μ at both high field and low field. The shielding coefficient can reach 99 percent and the device effectively reduced the fringe field and thereby allowed us to keep the original beam tube layout.

III. [as published] Testing Results

The D box fabrication began in July 1983 and, by the end of that year, external target beam adjustment was completed. Tests were performed at 9, 11, 20 and 30 MeV for p, at 16MeV for d, at 32MeV for α, and at 4.1MeV for H_2^+. Since we had already calculated the beam path and the compensation coil field parameters, we obtained the beam by simply implementing the design. Due to the good quality of the construction, the system has good stability and reproducibility of the beam characteristics. In order to save time, a number of deflection tests were performed before and during the internal target beam adjustments. Material and manufacture problems were solved in the process. Brass and aluminum parts located close to the high voltage electrode are replaced with bronze. The sharp angles of the electrode are rounded and polished, hence eliminating the problems associated with heavy electron load and voltage application in the forging process.

The table below shows the major results of the beam adjustments. The numbers quoted are for the following conditions: ion source window: 1.5 x 5 mm; gap: 1.5 x 20 mm; the geometric location and parameters of the fixed ion source, touch wire, gap and deflection plates are all based on a fixed orbit. The target spot of the large target chamber is 15 mm in diameter and that of the small target chamber is 20 mm in diameter. The straight feed through has a diameter of 20-25 mm. The transmission efficiency of the tube is 80-95 percent; and the time required to change the energy is 1-2 hours.

The cyclotron modification project has benefited from the enthusiastic support of the following units: Beijing Institute of Atomic Energy, Lanzhou Institute of Modern Physics, University of Beijing, Shanghai Electrical Machinery Plant, 5703d plant in Shanghai, First Steel Pipe Plant in Shanghai, Shanghai Lightbulb Plant, and Shanghai Radio Administration.

Energy (MeV)	Target chamber beam current (μA)	Energy spread ($\frac{\Delta E}{E}$ percent)	Time width (ns)	Extraction efficiency (percent)
p: 9	5.5 x 20	0.6	1.9	50 - 80
12	15 x 3.3	0.7	2.2	
15				
20	31 x 3.3		2.2	50 - 80
25	12.5 x 3.3	0.43	2.4	
30	20 x 3.3			
d 16	20 x 3.3			
α 32	1.2 x 3.3			
H_2^+ 4.1	3.7 x 20 na Triple frequency ϕ5 x 600 collimator			

9698
CSO: 4008/347

APPLIED SCIENCES

STATUS OF FUDAN VAN DE GRAAF REVIEWED

Shanghai HE JISHU [NUCLEAR TECHNIQUES] in Chinese No 2, Apr 85 pp 22-24

[Article by Yuan Daosheng [5913 6670 3932], Fei Zhiyu [6316 1807 1342], Lu Chengrong [4151 2052 2837], Sun Chuanchen [1327 0278 3819], Ye Kezhong [0673 0344 1813], Wu Peichun [0702 1014 2797], Jin Jiangqiu [6855 1696 3808], and Gu Yuanzhuang [7357 0337 1104]: [The Status of the Fudan Van de Graaf"]

[Text] Keyword: Van de Graaf accelerator

The Accelerator Laboratory of Fudan University converted its 2.5 MV proton Van de Graaf to a 4 MV accelerator[1] and the bulk of the conversion was completed in September 1979. Since then, a series of performance tests were made and the no-load voltage has reached 5 MV with the accelerator tube filled with 5 atmospheres of nitrogen gas. Because of accelerator tube problem, the particle energy failed to reach the 4 MeV target. Although a stable 3.2 MeV was once obtained during adjustment, the maximum energy available for experiments[2] was only 2.85 MeV. In this article we describe the operation of the accelerator in the years since 1981.

I. Applications of the Accelerator

In recent years the Fudan accelerator has been running about 3,000 hours per year. Research projects using the accelerator include the proton fluorescence project (including proton microprobe), the backscatter and channel analysis project, the beam foil spectroscopy project, nuclear reaction microanalysis project, the neutron physics project, the γ resonance project and the ion implantation project.

The applied research effort is mainly concentrated in the area of ion beam analysis technology, including microanalysis of nuclear reaction elements, backscattering and channeling effect, proton stimulated x fluorescence analysis, proton microprobe, and over trace amount analysis for the accelerator spectrometer. The advantages of ion beam analysis are: high sensitivity, simultaneous analysis of a number of elements, high analysis speed, nondestructive and not requiring a vacuum. Because of these district advantages, ion beam analysis has found wide applications in the national economy. In recent years, the ion beam analysis technique has been primarily used in material analysis, monitoring the manufacture of LSI circuits, analysis of

catalysts used in chemical engineering, pathology and metabolish studies, environmental monitor, archaeology and evidence material analysis, and the analysis of other ions and radiations.

II. Accelerator Improvements

1. Improvements of the electrostatic generator

The high voltage electrode profile is a third order parabola which makes a transition to the circular cylinder region,[2] as shown in Figure 1 [omitted]. This profile improves the electric field distribution around the electrode and around the first few voltage balancing rings and thereby increases the operating voltage. Aluminum electrodes of this profile have been used for 4 years with satisfactory results.

The voltage divider resistors of the original accelerator were installed between the voltage balancing skeletons of the accelerator pipe and the high voltage insulation post and the performance of the electrostatic generator cannot be tested without the accelerator pipe. We have modified the design and installed the voltage divider resistors directly between the voltage balance skeletons. Two new rows of protection ball gaps were added between the voltage balancing skeletons and the accelerator pipe and the high voltage post are connected with springs. When the high voltage fires, the spring plays the role of an inductor and protects the accelerator tube. The soft link between the accelerator tube and the high voltage post reduces the mechanical vibration and improves the stability of the particle beam.

The charge spray system of the accelerator is also improved. Metal screens replaced the original rows of needles and a current stability control ring was added.[3] These changes improved the natural stability of the accelerator.

2. Improvements of the beam system

The service life of the high frequency ion source has generally reached 500 hours or more. We made two changes here: (1) We used 99.9 percent pure molybdenum rods as absorbers, and (2) we integrated the quartz capillary and the shielding cover, accurately aligned the extraction system and improved the ratio of the extraction current and the anode current to 1:2~1:3 to reduce the ion current hitting the absorber. Since the sputtering of the absorber is decreased, the service life is prolonged.

Deflector plates oriented in the east-west and north-south directions are installed in front of the entry of the magnetic analyzer[4] to modulate the position of the entry beam. The voltage on the deflector plates is ±5 kV. The beam spot may be moved by 2 cm. For convenience of beam adjustment, the voltage may be controlled in the control room and at the entry of the magnetic analyzer.

In order to stabilize the beam position in the tube automatically, we used a setup that combined a magnetic guidance and a slit.[4] The beam deviation

signal from the slit controlled the current in the magnetic guidance so that the corrected beam would pass through the slit at the center. To control the beam in two directions, the slit was changed into a quadrant.

3. Improvements of the vacuum system

We made the following improvements to the vacuum system to prevent oil contamination of the accelerator tube. We used Chinese-made polyphenylether to replace the 275 silicon fluid in the main diffusion pump and improved the vacuum somewhat. The oil contamination in the tube was also less than before. It has been reported that using polyphenylether as a working fluid in the diffusion pump improved the resolution greatly and prolonged the service life as well. Our experience with using polyphenylether serves as a reference for future work with vacuum systems.

A molecular sieve adsorption trap was installed between the mechanical pump and the diffusion pump. This reduced the likelihood that oil vapor from the mechanical pump may backfill the vacuum system.

The bent tube vacuum system employed a vertical turbo molecular pump produced by the Zhejiang University. The pumping speed was 450 1/s and the new pumps produced a vacuum of 2×10^{-6} mmHg in the bent tube. It reduced the loss of the accelerated particles in transit and made the system practically oil free.

III. Accelerator Tube

The accelerator tube is the most crucial component of the Van de Graaf and poses the greatest difficulties in upgrading the energy. As is well known, the major reasons preventing further increase of the accelerator tube voltage are vacuum breakdown between the two electrodes, discharge at the surface of the insulation ring and incomplete breakdown discharge in the tube (electron load). With the present longitudinal gradient (<1/2 MV/m), surface discharge and breakdown between the electrodes can actually be avoided as long as the Van de Graaf is operated properly. Electron load, on the other hand, is the main cause that limits the improvement of the accelerator tube performance.

Since the electron load not only limits the maximum energy of the Van de Graaf but also spoils the focusing of the ion beam by the entry lens, it deteriorates the focusing of the ion beam and causes constant variations in the target beam intensity, beam size and beam position. If the vacuum in the tube is intentionally made worse, the threshold for electron loading in the accelerator tube may be raised substantially. Under our experimental conditions, the no-load voltage is raised by 80 percent and the output beam by 20 percent.

We have used three accelerator tubes of two different types on our Van de Graaf. One type of accelerator tube is a 115 mm diameter butterfly type. The electrode design of this type of accelerator tube insures that the secondary particles produced by the small number of accelerated particles hitting the electrode will enter the central region and not hitting the electrode

behind it so that electron multiplication can be avoided. The other type of accelerator has a 48 mm aperture flat plate electrode.[5] The design feature of this type of tube allows the secondary particles hitting the 25 mm aperture titanium grating to be deflected by the radial electric field at the junction of the two tubes and restricted within one section of tube (the accelerated particles generally will not hit the electrode). The latter tube is evidently more effective in suppressing the ion exchange process. Figure 2 shows the trajectory of the secondary particles in a tube with a 3.5 MV flat plate electrode. The stable operating voltage of both accelerator tubes has reached or exceeded 3 MV. No obvious electron loading was observed; however, as time increases the operating voltage decreases. To suppress electron loading and to increase the operating voltage in a deteriorated accelerator tube, we have tried to judiciously decrease the vacuum in the tube,[6] apply suppressing voltage, install small aperture grating and clean the inside of the tube. These methods have generally improved the performance and the best results were obtained by installing a grating.[2] Unfortunately, the service life of such "treated" tubes is generally less than 1,000 hours before the voltage drops to below 2 MV. Figure 3 shows the time dependence of the operating voltage for four acceleration tubes. After analyzing the usage conditions and the intrinsic quality of the tubes, we found that the main cause of electron load and voltage drop is the change of the electrode surface condition. Based on our experience, we found that the electron load and voltage drop is the change of the electrode surface condition. Based on our experience, we found that the electron load will increase and the voltage will drop when (1) the electrode surface adsorbs too much gas; (2) electrode surface is not clean and has a thick layer of oxide; (3) the electrode surface is seriously contaminated by organic matters--mainly oil vapor; and (4) the electron surface is improperly cleaned and has loose matters adhered to it. Generally speaking, when the electrode surface is badly contaminated by oil or has excessive amount of foreign particles, the performance of the tube cannot be restored by "training" or by simply replacing the grating.

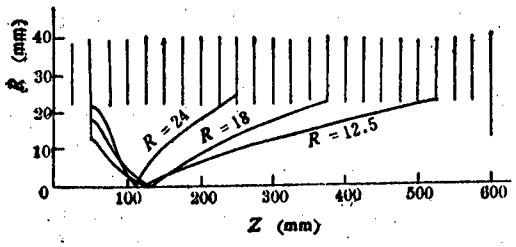


Figure 2. Trajectory of the Secondary Particle in a 3.5 MV Flat Plate Electrode Acceleration Tube (V = 4 MV).

We understand, based on the theory of ion exchange and ion cluster in vacuum discharge, that: (1) the increase of the secondary particle emission coefficient of the electrode surface is closely related to the surface contamination,[8] and (2) particles adhered to the electrode surface become charged and separated from the electrode. These particles are accelerated

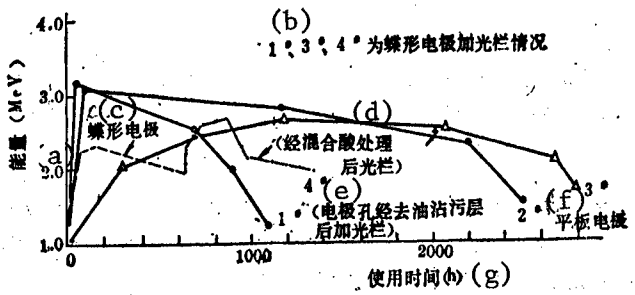


Figure 2. Trajectory of the Secondary Particle in a 3.5 MV Flat Plate Electrode Acceleration Tube (V = 4 MV)

Key:

a. Energy
b. #1, #3 and #4 correspond to butterfly electrodes with added grating
c. Butterfly electrode
d. Acid treated and then adding a grating
e. Electrode orifice degreased and then adding a grating
f. Flat plate electrode
g. Operating time (hours)

in the high voltage gap and eventually hit the electrode on the other side.[7] When the electrode is heated locally, the increased temperature causes the release of a large amount of gas and leads to discharge between the electrodes. In addition, it may also cause metal evaporation and melting and hence leading to discharge between the electrodes. If the electrode surface has crystal whiskers, an approaching charge particle may also lead to field emission from the cathode surface, followed by discharge (microdischarge) caused by the rising vapor pressure between the particle and the cathode. Such microdischarge may trigger a discharge between the electrodes. From the qualitative analysis above, we see that the secondary emission increases when the electrode surface is contaminated. Since the presence of particles causes microdischarge and breakdown between the electrodes, and both will promote the ion exchange process in the acceleration tube, the results are an increase of the electron load and a decrease of the tube voltage. The process is obviously nonreversible and our experimental data bear that out.

The authors thank the Xianfeng Electrical Machinery Plant for their timely machining of many components, the Zhongnan Rubber Plant research laboratory for providing the Dacron belts, Comrade Lai Weichun [6351 0251 0356] of the Shanghai Nuclear Institute for computing the trajectories of secondary particles in a flat plate acceleration tube. The following people have also participated in this study: Jin Guanshun [6855 6034 7311], He Mianhong [6320 0517 1347], Fu Taoxian [0265 2711 6343], Zhang Gholu [1728 6665 6424], Zhang Xianming [1728 0341 2494], Shi Wei [2457 0251], and Mo Qinggao [5459 1987 7559].

REFERENCES

1. Fei Zhiyu, et al., "Modification Proposal and Progress Report of the Van de Graaf," Proceedings of the First National Accelerator Technology Exchange, 1979.

2. Gu Yuanzhuang and Fei Zhiyu, "Progress on the 4 MV Van de Graaf," Proceedings of the First National High Voltage Accelerator Technical Exchange, 1981.

3. Lu Chengrong, et al., "Improvements of the Spray System of the Van de Graaf," Proceedings of the Second National High Voltage Accelerator Technical Exchange, 1983.

4. Fei Zhiyu, et al., "Position Monitor, Guidance and Control of a Van de Graaf," First Symposium on Beam Measurement and Control, 1983.

5. Yu Juesian [0151 6030 0341], et al., "Development and Preliminary Test Results of a 3.5 MV Acceleration Tube," ATOMIC ENERGY SCIENCE AND TECHNOLOGY, Vol 1 No 42, 1982.

6. Ye Kezhong, et al., "A New Regeneration Method for Old Acceleration Tube in a Van de Graaf," Proceedings of the Second National High Voltage Accelerators, 1983.

7. Chatterton, D.A., J. APPL. PHYS., Vol 43, 1972 p 4536.

8. Ye Minghan [0673 6900 3352], et al., "Van de Graaf Accelerators," 1965 p 324.

9. Wang Keli [3769 0334 4409], "Notes on Tandem Accelerators," 1979 p 51.

9698
CSO: 4008/347

APPLIED SCIENCES

USE OF REMOTE SENSING, GEOPHYSICAL PROSPECTING IN NUCLEAR POWER PLANT SITE SELECTION

Beijing WUTAN YU HUATAN [GEOPHYSICAL AND GEOCHEMICAL EXPLORATION] in Chinese
Vol 9, No 2, Apr 85 pp 86-91

[Article by Chen Changli [7115 2490 4409] of the Ministry of Geology and Mineral Resources' Bureau of Geophysical and Geochemical Exploration]

[Text] Abstract

Nuclear energy is a safe, clean, and cheap energy source. Nuclear power plant construction should be based on strict geological surveys and technical designs. This article introduces the tasks and requirements of remote sensing and geophysical prospecting work during each stage of nuclear power plant site selection and, based on China's real situation, proposes that remote sensing and geophysical work in each stage of nuclear power plant site selection be organized according to the concepts of systems engineering.

Safety, cleanliness and low cost continually are increasing the competitive position of nuclear power stations among the ranks of new high-power energy resources. By 1983, 25 nations of the world had completed construction of 317 nuclear power plants with a total installed generator capacity of 191,400 MW, equal to 12 percent of total world energy resources. The world also has 209 nuclear power plants under construction with a planned total installed generator capacity of 194,000 MW. Nuclear energy will account for 31 percent of the structure of world energy resources when they are completed.

Nuclear power plant construction is established on the basis of strict geological prospecting and design that focus on the stability of stratigraphic structures and environmental forecasting. International atomic energy organizations have compiled a series of articles on safety to ensure the safe operation of nuclear power plants. The U.S. Nuclear Regulatory Commission has formulated a set of regulatory guidebooks and made clear and strict stipulations concerning the various types of geological prospecting work required during each stage of site selection. The U.S. Geological Survey [?] has compiled a volume of collected articles that interpret the standards based on geological exploration experience at 100 already constructed nuclear power plants. The Ministry of Geology and Mineral Resources convened a discussion meeting of chief engineers concerning remote sensing and geophysical prospecting work as

a part of geological work in nuclear power plant site selection. It introduced foreign articles on related topics and exchanged experiences gained within China. This article offers some general suggestions concerning the tasks and demands of remote sensing and geophysical prospecting work during the different stages of nuclear power plant selection as a reference for my comrades.

I. Remote Sensing and Geophysical Prospecting Work During the Different Stages of Nuclear Power Plant Site Selection

Nuclear power plant site selection in China and abroad has been divided into three stages. Remote sensing and geophysical prospecting work have definite tasks during the site selection and operation stages.

1. The pre-selection stage

Collect 1:500,000 to 1:1,000,000 satellite photographs and regional aeromagnetic and gravity data within a radius of 300 kilometers from nuclear power plants for interpreting regional structures and linear structures and provide information concerning regional fault trace lines. Collect data on natural earthquakes and seismic depth measurements within the region and analyze the seismic activity and deep structures of the region. Make a preliminary evaluation of the regional structural characteristics, regional structural stability and regional environmental geology of a group of candidate sites, eliminate most of them and keep a few to serve as preliminary sites for nuclear power plants.

2. The preliminary selection stage

Collect small-scale remote sensing space images and aeromagnetic and gravitational data for the small number of nuclear power plant sites that were proposed during the pre-selection stage. Make detailed interpretations of regional structures at the pre-selected sites, calculate regional gravitational fields and Mohorovicic discontinuity depth charts, do extrapolative elevational analysis of different aeromagnetic data, integrate data on seismic measurements and chart regional deep faults. Collect historical and instrumental earthquake information and primitive records of major earthquakes, accurately re-determine earthquake epicenters through computer processing during earthquakes and provide precision maps of epicenter locations within a radius of 300 kilometers from the plant site to locate islands of safety.

Develop interpretation of large-scale aerial remote sensing images and interpretation of aeromagnetic and gravitational data for nearby regions (within a radius of 8 kilometers). Develop high-resolution contental and marine seismic reflection surveys and do research on the scale and nature of the major faults and active faults in the nearby region. Especially important is to use remote sensing images and seismic reflection data to determine whether or not the faults cut through the Quarternary system. Study the relief of the bedrock, underground water levels, basement collapse, landslides and mud and rock flows, and other questions.

Use the above data for an Early Site Recommendation Report (ESRR) to provide demonstration data and attachments.

3. The project site selection stage

Develop the necessary remote sensing and geophysical prospecting work for preselected nuclear power plant sites and prepare data and attachments for a Preliminary Safety Analysis Report (PSAR). Work in the following areas should be developed:

1) Collect large-scale aerial remote sensing images and make certain types of remote sensing flights as needed (such as multispectral, colored infrared and color photographs, thermal infrared or side-looking radar, etc.) to compile detailed geological maps and environmental engineering geology maps. Detailed interpretations at the specified breadth and scale should be made for faults that cut through the surface.

2) Develop high-resolution seismic reflection or seismic refraction, drill survey wells and do geophysical prospecting below the wells, and make detailed studies of strata, structures and faults near the plant site and their activities.

3) Develop microseismic monitoring of capable faults and record accurately the locations of micro-earthquakes coming from these strata. Develop constant monitoring of micro-movements and classify small seismic regions. Develop measurement of ground stress and changes in surface features (high-precision benchmarks and distance measurements) or collect these data to investigate fault activity.

4) Measure the minimum age of fault activity. This mainly involves using paleomagnetism and multiple isotopes to determine absolute ages.

5) Develop on-site measurement and laboratory measurement of the parmeters of rock and soil dynamics.

6) Provide project design data on excavation and refill for nuclear power plant construction. Develop shallow strata seismic refraction prospecting.

Submit a Preliminary Safety Analysis Report. Do supplementary work after it has been sent to management departments for inspection and make revisions, and then submit a Final Safety Analaysis Report (FSAR).

4. The construction and operation stage

Apart from the tasks during the three stages of nuclear power plant selection stipulated in the standards, remote sensing and geophysical prospecting also have tasks during nuclear power plant construction and during the operation stage after they are completed.

Remote sensing and geophysical prospecting should be combined as needed for detailed exploration work during the construction stage. Study the underground situation in excavation projects and carry out quality inspection after grouting the cement, undergound water level and water quality monitoring and so on. This mainly involves the use of shallow strata seismic refraction, sound waves and survey wells, and so on.

The operational period after a nuclear power plant is completed requires the establishment of a network of permanent fixed microseismic stations to monitor seismic activity near the nuclear power plant. The intensity of environmental radiation (including the atmosphere, river basins, land masses and the biosphere) should be surveyed before a nuclear power plant is operated to evaluate the effects caused by nuclear power plants. Monitor nuclear radiation in the environment and the surface water and underground water near nuclear power plants as needed. In order to estimate the amount of hot water discharged into rivers, lakes or underground by nuclear power plants and to evaluate the cooling efficiency of cooling towers and cooling tanks as well as thermal losses in nuclear power plants, there should be aerial infrared scanning or measurement of temperatures in shallow underground strata to evaluate the scope and intensity of thermal discharge and the danger of the environment.

Sites suitable for permenent storage of nuclear wastes such as deserts, the ocean, salt domes and salt strata, granite and so on should be surveyed for storage of nuclear wastes. Remote sensing, surface geophysical prospecting and well survey work should be developed.

II. Tasks and Requirements

The tasks and requirements during the three stages of remote sensing and geophysical prospecting work for selection of nuclear power plant sites are:

1. Study the characteristics of strata and structures near and distant from plant sites.

1) Use space remote sensing images to derive interpretive remote sensing geological maps and interpretive remote sensing engineering geology maps (including geomorphologic maps, rock and soil mechanics distribution maps, maps of key hydrogeological features, ectodynamic geological images, etc.). Or, combine with surface geological surveys to provide detailed information on charting components, main features and boundary lines. Or, existing geological maps, structural maps and engineering geology maps can be revised.

2) Collect aeromagnetic and regional gravitational data and use digital processing to provide maps of residual gravitational abnormalities, depth charts of the Mohorovic discontinuity and other features, aeromagnetic abnormality charts, maps with different degrees of analytical interpretation and other maps. Collect seismic depth measurements for studying regions, depths and regional structures.

3) Collect maps of earthquake epicenter distributions. The precision of epicenter location determination on the maps should be investigated. Computers should be used when needed for re-processing to determine epicenter locations. There are different requirements for the precision of epicenter locations for different time period:

a) For recent years, the precision of machine-recorded epicenter locations should be 5 to 10 km.

b) Records since 1950 should have a precision of earthquake epicenter location of 10 to 20 km.

c) Records since 1930 should have a precision of earthquake epicenter location of 20 to 30 km.

d) For records before 1930, use only those with a precision of 30 kilometers or less at the time.

4) Based on space remote sensing images at different scales, interpret primary factors of environmental engineering geology, especially landslips and mud and rock flows, surface collapse, ancient river beds and so on for verification through surface inspections. Use surface geophysical prospecting methods to determine the nature of landslips and the degree and scale of collapse near the plant site.

5) Use high-resolution shallow strata seismic reflection, shallow strata seismic refraction, sound waves and in-well perspectives to determine the depth and relief of the basement rock surface, the thickness of the Quarternary cap, faults beneath the Quarternary cap, the geological structure of the basement rock and soft interbedded strata, possible karst caves in the basement rock, and so on.

6) Use seismic methods and well measurements to determine the structure of Quarternary sediments (velocity differentials), water-bearing strata, water table, the thickness of the weathered surface of the basement rock, the degree of weathering, underground water discharge points in fissures, density of fissures and so on.

2. Study faults.

One very important and serious task in geological work for nuclear power plant site selection is to investigate faults far afield and nearby, as well as close to the plant site. The scale for investigating faults is related to the distance between the fault and the plant site. The distances required for investigating faults of differing lengths are shown in Table 1.

Table 1. Distance between Faults and Plant Sites and Range that Should Be Investigated

Distance between fault and plant site in miles (kilometers)	Shortest fault that should be investigated in miles (kilometers)
0 - 20 (32)	1 (1.6)
21 - 50 (80)	5 (8.0)
51 - 100 (32)	10 (16.0)
101 - 150 (240)	20 (32)
151 - 200 (320)	40 (64)

Faults that have the following direct or indirect indications on remote sensing images and geophysical charts should be investigated for research and verification:

1) Faults reflected as geological phenomena on remote sensing images.

Contact between geological materials with different qualities, loss or repetition of strata, or truncation of strata and structures.

2) Faults reflected as geomorphological components on remote sensing images.

Discontinuities of levels in water systems, subsidence lakes or a linear distribution of depressions, a series of springs or volcanoes, hot springs, ground fracture lines, cliffs or triangular surfaces along mountain ridges, inclined terraces or large changes along ocean coastlines, abnormal inclines or slopes, large differences in vegetation of colors on images.

3) Reflections of faults on geophysical planar maps or profile maps.

a) Belts of dense inclined or linear gravitational or magnetic contours, seismic wave velocity abnormalities, discontinuities in seismic reflection strata, discontinuities in comparative positions of strata in bore-hole well measurement profiles, a linear distribution of natural earthquake epicenters, or a planar distribution of earthquake origins.

3. Study fault activity.

Research on fault activity is a key topic for evaluating nuclear power plant site selection. The determination of whether each fault is active or not is extremely important and the work should be done seriously and strictly.

1) The definition of capable faults: Faults where at least one instance of activity has occurred at or near the surface within the past 35,000 years, or where there has been repeated activity over the past 500,000 years.

2) Indicators of fault activity: There are many geological indicators and data for determining fault activity. The indicators provided by remote sensing and geophysical prospecting data include:

a) Contact between Quarternary sediments and older strata that form faults on remote sensing images indicates that the fault cuts through Quarternary sedimentary strata.

b) An indication of a fault in Quarternary sediments on seismic reflection profile charts.

c) A linear arrangement of earthquake epicenters or a linear distribution or clustering of microseismic epicenters in microseismic record collection after more precise locational determinations.

d) An obvious vertical rise in the crust or changes in levels during high-precision bench mark and distance measurements between fixed points.

3) Based on the definition of capable faults, use palemagnetic and various isotopic methods to measure the minimum age of the fault's activity. The method and scope of their utilization are:

a) The C-14 method, which is suitable for use in faults that are filled with calcium material and for measurements within a range of 40,000 years.

b) The racemic method based on alkalinity or acidity, which is effective for organic matter and has a measurement range of 5,000 to 35,000 years.

c) The U-Th (uranium-thorium) method, which is suited for the filler in calcite veins. It has a measurement range of 81,000 to 170,000 years and a maximum of 300,000 years.

d) The K-Ar (potassium-argon) method, which is suited to volcanic rock and magmatic rock and has a rather broad measurement range of about 1 million years.

e) The Rb-Sr (rubidium-strontium) method, which has a measurement range of 80 million years.

f) The atomic fission track method, which is temperature-sensitive and can be used for measurements of 1 million years.

g) The thermal luminescence method, which is suitable for limestone and dolomite, and has a measurement range of 25,000 years.

h) The liquid impurity method, which is a pressure and temperature method that can be used to measure the minimum age of crystallized material that fills faults.

i) The palemagnetic method, which is suitable for use in rock veins or sediments that displace or extend beyond the strata. The range of age measurement is rather wide, but it cannot be used after the late Quarternary.

4) There is a broad range of remote sensing and geophysical prospecting work for examination of faults that break the surface. Detailed work must be done if an active fault or one that cuts through to the surface is discovered. The breadth of the work region is related to the size of the area controlled by the fault and the level of earthquakes that have occurred. The stipulations are:

a) The area of the investigation should be identical to the area controlled by the fault for earthquakes at a scale of less than 5.5.

b) The area of the investigation should be twice that of the area controlled by the fault for earthquakes at a scale of 5.5 to 6.4.

c) The area of the investigation should be three times that of the area controlled by the fault for earthquakes at a scale of 6.5 to 7.5.

d) The area of the investigation should be four times that of the area controlled by the fault for earthquakes at a scale of 7.5 or greater.

III. Parameters

The use of geophysical prospecting methods to determine parameters of soil and rock mechanics is an important basis for project design. The main parameters are:

$$G = \rho V_s^2$$

$$\sigma = \left[1 - 2\left(\frac{V_s}{V_p}\right)^2\right] \Big/ \left[2 - 2\left(\frac{V_s}{V_p}\right)^2\right]$$

$$E = 2G(1 + \sigma)$$

In the formula, V_s= wave velocity of horizontal waves (shear), V_p= wave velocity of vertical waves (compression), p = density, G = shear modulus, σ = Poisson ratio, E = Young's modulus.

1. Use seismic and sound wave measurements to evaluate rock and soil mechanics and qualities.

1) Measure the injection coefficient N in soil, which has a very good inter-relationship with V_p and V_s. The linear equation for N--V_s is:

$$\log V_s = 91.0 - 0.337 \log N$$

2) The ultimate compressive strength of soil and rock:

$$q = aV_p^2$$

The compressive strength is $R_c = aV_p^2 + bV_p + C$ and is used to evaluate the integrity of rock.

3) The experiential relationship between dynamic and static elasticity moduli is:

$$E_s = 0.01 E d^2$$

4) The rock quality division (RQD index) is shown in Table 2).

Table 2. Rock Quality Categories

Rock quality grade	RQD Index	V_p (km/sec)	Velocity ratio $(V_b / V_p)^2$
Extremely bad	0 - 25	1.0 - 2.0	0.0 - 0.2
Bad	25 - 50	2.0 - 3.0	0.2 - 0.35
Acceptable	50 - 75	3.0 - 4.0	0.35 - 0.6
Good	75 - 90	4.0 - 5.0	0.6 - 0.8
Extremely good	90 - 100	> 5.0	0.8 - 1

2. Calculate a permissible parameter for horizontal acceleration.

The permissible value of horizontal surface acceleration to determine the grade and intensity of earthquakes near nuclear power plants under the mechanical conditions of the plant site is an important index for nuclear power plant construction. The U.S. stipulates the level at 0.10 g for 90 nuclear power plants and at 0.20 to 0.25 g for 5 plants. China allows 0.1 g at the present time.

The use of trans-hole normal seismic locations to measure shear wave velocity in the rock and soil between two wells is a key item of work. Formulate a mechanics model for the plant site based on the measured value V and input the time--history of the maximum earthquake. The output horizontal acceleration value is less than 0.1 g.

3. Liquefaction

Seismic shear causes liquifaction of water-bearing friable sediments. During design, assume that 0.35 g occurs at the surface (the conservative value is 0.5 g). The duration and degree of shear determine whether or not water-bearing friable sediments liquify, and it also reflects the normal position situation of ultimate pressure and nature of the dielectric. The measurement ratio is:

$$\frac{\text{Indoor measurement of the periodic coefficient when determining the shear pressure value}}{\text{Periodic coefficient observed for an identical shear pressure value during the during the process of normal position input shear pressure}}$$

The critical value of the safety coefficient is when the ratio is less than 1. Liquifation is possible when it is less than 1. The conservative requires that the ratio reach 1.50.

4. Tracer experiments.

Isotope tracing technologies should be used to measure diffusion rates and distribution coefficients for studying environmental pollution from the infiltration of nuclear materials spilled from nuclear power plants into the underground water.

1) The diffusion rate (dimensional length) refers to the degree to which the diffusion of nuclear material causes the concentration of nuclear material to fall below the maximum permissible concentration (MPC). This generally involves using the isotopic solution observed in the wells to measure the solution concentration (radiation intensity) in the solution from inside the well at different times.

2) The distribution coefficient is the ratio between the amount of pollutants absorbed in the structure of water-bearing strata and the residual amount in underground water. The reduction in pollutant concentrations caused by absorption will reduce the level below the maximum permissilbe concentration (MPC).

IV. Some Proposals

It can be seen from the above work tasks that remote sensing and geophysical prospecting are widely used and play an important role throughout the various stages of nuclear power plant site selection up to the construction and operations stage. Nuclear power plant construction is a comprehensive embodiment of modern scientific and technical levels. Geological and geophysical work for nuclear power plant selection also should reflect modern technical levels and meet the needs of nuclear power plant construction. For this purpose, I propose that:

1. The concepts of systems engineering should be used to organize remote sensing and geophysical prospecting work during each stage of nuclear power plant site selection, and they should be integrated organically into the overall design of geological work as a whole. The concepts of systems engineering require that the sciences used in each method be organized organically to correspond to different stages and that they provide optimum programs to avoid a loss of coordination and mutual detachment within each of the methods.

2. The fact that prospecting work must be complete and serious and the many types of methods requires coordination of levels. Often this cannot be undertaken entirely by the technical staff of a single unit. For this reason, primary specialized personnel should be involved in comprehensive design and organize mutual coordination of all types of work.

12539
CSO: 4008/362

LIFE SCIENCES

EFFECTS OF NUCLEAR WAR ON COMBAT TROOPS DISCUSSED

Beijing JIEFANGJUN YIXUE ZAZHI [MEDICAL JOURNAL OF CHINESE PEOPLE'S LIBERATION ARMY] in Chinese No 2, 20 Apr 85 pp 143-145

[Article by Zhu Renbao [2612 1103 5508], Radiation Medicine Research Center, Academy of Military Medicine: "The Task of Radiation Medicine and Its Role in a Future War"]

[Text] The destructive and killing factors of nuclear war, in addition to nuclear radiation and its characteristic function, such as direct injury by shock waves or by ray radiation, may all be included within the field of battle injury surgery. This article gives merely a general discussion of radiation medicine.

Nuclear radiation is a kind of physical factor, which has a positive and beneficial aspect for the human organism, but which at the same time has a negative and harmful aspect. The instantaneous radiation from nuclear weapons can create injuries to the human body of differing degrees, even death, which then raises the task for medicine of research into treatment. Where injuries from radiation are different from other injuries is in the fact that the wounds cannot be seen, that within a short period of time the degree of the wounded condition cannot be determined, since only after a certain period of time do the early symptoms appear. There is a direct relation between the time when these symptoms appear and the radiation dosage. With irradiation by a rather large dosage, early symptoms will appear early and will be rather severe; with lower doses, symptoms will be later to appear and will be lighter. Therefore, in nuclear war radiation sickness will be a prominent problem, which is to say that in radiation medicine treatment is a central topic of research.

Research into acute radiation sickness includes three questions. First, study of radiation dosage; second, prevention of radiation injury; third, treatment of radiation injury. The close relation between radiation dosage and the degree of radiation injury divides at present acute radiation sickness into three types, that is, of blood forming areas (also called the marrow area), of stomach-intestinal areas (called intestinal for short), and of the brain. Radiation sickness caused by a radiation dose of from 1 to 8.0 Gy (1 Gy=100 rad) belongs to the blood forming type; radiation doses of 10 Gy and above produce intestinal radiation sickness; doses that affect radiation sickness of

the brain must be of tens of Gy. Because radiation dosage is the basis for judging and producing radiation injury, in the diagnosis of radiation injury, and especially in the diagnosis of population radiation injuries or in accidental injury by radiation, dosage study is extremely important. Workers in nuclear industries and mining must carry a personal radiation dosimeter, by which means it can be determined what dosage of radiation is received during normal work, and which is the basis for improvements in the hygienic conditions of plants and mines; in certain kinds of special work in plants and mines, when it is hard to avoid ray radiation, one can check the actual amount of dosage received on the personal dosimeter carried by the worker, which will be the basis for health measures; in conditions of war, military personnel should also carry personal dosimeters, then in the event the enemy uses nuclear weapons it will not be difficult to know the conditions under which a unit sustained its injuries. There are, however, limitations to use of the dosimeter because many factors can affect the accuracy of the numbers reflected by the dosimeter. Even so, research into radiation metrology and development of various dosage instruments are still very important in modern warfare. Since the end of the Second World War there have been rapid developments in radiation metrology research, and various radiation dosimeters have had on-site usage. Current radiation metrology research is constantly developing in depth, and in the development of instrument design, reductions in size and weight have been goals, as has improvement in sensitivity. Although there are already personal dosimeters for sale on the world market, there is not yet a satisfactory product for use by military personnel, this still needing more advanced development.

There have been advances in all countries in the prevention of radiation injury, and especially research into medicinal prevention, but the problem has not been truly resolved. Because of the instantaneous radiation from a nuclear blast, unless when warned one takes cover in strong fortifications, it is very difficult to guard against radiation injuries. Many infectious diseases can be prevented by vaccines, but rays can destroy the body's immune functions and keep the body from producing antibodies. Therefore, radiation sickness cannot be prevented via the immune system, but even so, there has been a certain amount of effort in this direction by researchers in many countries, and what is more, they have had some results. At first, researchers sought to understand what factors cause radiation injuries, that is, what is the initial reaction produced by the body. After a great amount of research it has been shown that radiation can ionize the moisture content in the body, and within a short time produce a great many very active oxidized free radicals. Although the time that these oxidized free radicals exist is very short, they are however quickly used by many biological macromolecules, such as proteins and nucleic acids, which destroys their molecular structure, consequently causing them to lose a certain amount of activity and function. This is the earliest cause of radiation sickness. Later, researchers proceeded from this idea of ionization and tried as hard as they could to find many chemical compounds to inject into an organism before irradiation, which would compete with the body's biological macromolecules for the oxidized free radicals. This would consequently protect the structure and function of many biological macromolecules in the body, would avoid injury, or would lessen the degree of injury, which would accomplish the goals of prevention. Others focussed on a series of physical, chemical, and biochemical links produced by

the body in reaction after irradiation, and searched for relevant chemical compounds to block these reactions, and consequently to not allow this very complicated physical and chemical reaction process to develop to the point of injuring the body, which would accomplish a goal of preventive significance. With these intentions in mind, some chemical compounds were eventually found, which after injection or oral consumption into the body before the body received radiation could clearly reduce injuries by radiation and improved the rate of survival by animals after radiation. This was an important research result for radiation medicine. Looking from the view of prevention, the instantaneous radiation from a nuclear blast is very difficult to guard against. First of all, we do not know when an enemy will use nuclear weapons; second, the effective duration of prevention pills is limited, and moreover the ill effects of many prevention pills are great, so they cannot be taken or injected successively. Of course, if a certain kind of medicine could not only be taken effectively before irradiation but also could be taken a short time after irradiation and still function as a protection against radiation injury, its actual practical value would be much greater. However, these so called radiation pills can actually only serve to lessen radiation injuries. At present, it seems that radiation injuries cannot be completely avoided. But radiation illnesses that can be cured are certainly limited in the current level of medical practice.

Treatment of acute radiation sickness is carried out on the basis of general medicine, it is based upon developments in a patient's condition and is directed towards the characteristics of the symptoms. Summing up the clinical experience from animal experiments and from victims of radiation accidents, the development of blood-forming type radiation sickness has clear stages. Symptoms that appear in the early period after irradiation are called the formation period response; there follows a period of false recovery or incubation period; finally, there it enters the acute period with a series of typical symptoms of radiation sickness, as for example, hair loss, blockage of the blood forming function, bleeding, infection, etc., all of which signs become apparent. If the patient can survive through the acute period, his condition will turn to a period of recovery, and the various symptoms will gradually disappear until there is complete recovery. Measures for treatment largely follow the principles of taking medicine for the symptoms, where the best results are obtained when the medicine is administered before the symptoms appear.

There is currently no effective treatment for the intestinal and brain types of radiation sickness, but all countries are engaged in such research. The primary symptom of intestinal radiation sickness is vomiting and diarrhea, with great losses of water and electrolytes, which causes a loss of acid-base equilibrium in body fluids. In the case of animals, they will usually die within 3 to 5 days (mouse) or about a week (dog); survival of monkeys and men is somewhat longer, but they will usually die as well within about 10 days. The symptoms of brain type radiation sickness are completely of the central nervous system, as in dizziness, inability to tell direction, asynergia, twitching, etc.; there is an early loss of ability, progressing to complete loss of central nervous control, which is characteristic of brain type radiation sickness. As for the treatment of intestinal radiation sickness, one research direction with some promise is bone marrow transplant combined

with electrolyte transfer, but for the moment it is still difficult to solve the problem of the transplanted material resisting the host illness. There has also been some work done abroad on emergency treatment for brain type radiation sickness. By using certain drugs (for example, a kind of sedative) one can delay the occurrence of incapacitance and other symptoms, which could be significant militarily.

Besides the instantaneous radiation, products of nuclear fission might also cause acute radiation sickness from external irradiation. However, radioactive fallout after a nuclear blast can enter through inhalation, or can get into the body by ingestion or through wounds in the skin to cause internal radiation sickness, which is also worth noting. The decay time for the majority of fusion products is quite short, but for some of them it is quite long. What is more, some of them have a particular affinity for certain tissues in the body, as for example, strontium (^{90}Sr), polonium (^{210}Po), plutonium (^{238}Pu), iodine (^{131}I), etc., which can cause injury to the body of differing degrees, even serious, long-term effects. Other important research topics in radiation medicine are how to therefore prevent these isotopes from entering the body, and if already inside, how to bring about their quick removal.

We have briefly discussed above the research tasks for radiation medicine and their progress. We ought also to discuss what function these topics can play in battle. Scientific research ought to link theory with practice, which is a principle scientific workers adhere to. In radiation medicine, the goal of one kind of research topic is extremely clear, which is to solve certain practical questions, such as the prevention and treatment of radiation injuries. But there is also a topic that lays particular stress on theoretical research, which is that to solve practical problems we must clarify theoretically the nature of the problems.

In the work of peacetime use of atomic energy it is possible that there will be radiation accidents and even injuries, and under conditions of battle, and the instantaneous radiation of nuclear blasts, it is even easier to have radiation sickness of varying degrees, and this to a great extent. As for the handling of those injured in accidents, we have already accumulated a relative abundance of experience, and it is not difficult to save injured personnel; but the great number of those injured by radiation in warfare is not a simple or easily answered question. In this we need to be concerned with such military science questions as hygiene services and civil defense organizational structures. Only by carrying out warfare according to the principles of military science, as for example in constructing civilian fortifications, organizing rescue units, etc., can we reduce military and civilian losses, as well as to allow many scientific results to fulfill their roles in actual combat. Because guarding against nuclear attack is a very complicated question, and we currently lack materials that are the results of experience in nuclear warfare, we can only talk about the following problems theoretically.

1. The problem of equipment for soldiers: in order to defend against injuries from instantaneous radiation from nuclear weapons, we currently have no well-considered plans for what soldiers ought to be provided with. But

from the standpoint of individual protection needs the following kinds of equipment might be necessary. 1. A personal radiation dosimeter. If an enemy uses nuclear weapons during warfare, the distance of each soldier from the center of the blast could vary considerably, and the differences in degree of injury could naturally also be very great. If each soldier is equipped with a personal dosimeter, then to a certain degree it could be understood what dosage each casualty had received. However, the dosage read from the dosimeter could vary considerably, but it can at least be seen that this is significant reference data for reference for categorization and handling of conditions of injury. 2. As for radiation protection drugs, when intelligence is received that the enemy is going to use nuclear weapons, then one can take a dose, and after the nuclear explosion can take another dose, in which way the effects would be best. 3. Purification tablets for radioactively polluted water. Drinking water and food for combat units cannot be taken along for a long period of time, but rather must be provided as one finds them. Under conditions of nuclear war primary water sources and foodstuffs might all be contaminated by radioactivity, for which reason water purification tablets ought to be included as an item in individual equipment, in which way may be solved the local water usage problem during nuclear warfare. However, individual provisions cannot be too many, because otherwise that will weaken the soldier's fighting ability, so there should also be certain collective provisions to supplement insufficiencies in individual provisions.

2. Handling personnel wounded by radiation on the battlefield: the number of people injured by radiation during a nuclear war will be very many, and there will be great differences in the severity of those wounds. In order to maintain the fighting power of a unit, as well as to allow timely treatment for certain injuries, categorization of wounded personnel is very important work. The standardizations for categorization may be according to the radiation dosage indicated by the radiation dosimeter carried by the individual, according to the physical signs evident during a period of time after irradiation, or whether or not anti-radiation drugs have been taken after irradiation, or whether there is radioactive pollution on body surfaces or clothing, as well as what the casualty can say after the blast. After this, make an initial diagnosis, or send the person back to the front lines to rejoin his unit to continue participation in the battle, or send him to hospitals in either forward positions or rear positions for treatment.

3. Key training for preventative atomic medicine: ordinarily, the number of people doing research work in preventative atomic medicine is very few, but if there should be a nuclear war, the entire country could become a battlefield because rear position communication nodes, strategically important places, and economic, political, industrial, and cultural centers could be bombed by an enemy. There is therefore need for a great number of personnel in preventative atomic medicine. In order to fulfill this demand, to reduce losses to armed units and unarmed personnel and losses caused by nuclear attack, we ought to train a great number of preventive atomic medical personnel using the training class method before warfare breaks out, as well as within a relatively short period after war begins, assign work to each battle area and rear areas, prepare anti-radiation capabilities, allocate materials for defense against nuclear warfare, and set up treatment bases to

prepare for developments in the situation and effectively take up work. In order to deal with this urgent battle tasking, treatment personnel throughout the country and administrative cadre, from youth through middle age, ought to undergo this kind of training, for otherwise there will not be enough to handle that kind of serious situation. This is because wartime treatment structures cannot be divided into front or rear areas, military or civilian use.

4. Field treatment structures: in addition to provision with first-aid drugs and equipment for conventionally wounded soldiers, we must consider the drugs and equipment needed for saving wounded personnel who have received a great deal of radiation. In providing these two types of first-aid materials, although there is not much difference between them, each has its characteristics. For the soldier with general radiation injuries, anti-infection drugs and transfusion and electrolytic supplements are most important. For casualties with acute intestinal radiation sickness survival is possible with transfusion and supplement of electrolytes, since death is related to great losses of fluids. But where the radiation dosage has been excessive, to the point that blood forming organs and immune functions are nearly completely destroyed, this will then depend upon special measures before the injured person can rebuild his blood-forming and immune functions, by which is meant the bone marrow transplants mentioned above. There are blood forming stem cells in bone marrow, which are dedicated to the healing of defects in blood forming and immune functions. These cells are primarily in bone marrow, and at the same time exist in peripheral blood and in fetal liver (there is most in a 4 to 5 month fetus liver). At present we cannot separate blood forming stem cells from immunocompetent cells, so when transplanting bone marrow or peripheral blood single nucleus cells (containing blood forming stem cells), it is difficult to avoid resistance of the transplanted bodies to the host disease, so this cannot be used directly in clinics. As for fetal liver cell transplants, although there are relatively few immunocompetent cells in them, and resistance to the host illness by transplanted materials is relatively light, for some unknown reason it is still not easy to implant them in a wounded body. Possibly, the blood forming microenvironment of adults is not suitable for the existence of fetal liver blood forming stem cells. These problems are still at the research stage.

The quantities of wartime material provisions are enormous, which creates a certain amount of tension in provisioning. Those responsible for allocating materials for combat preparedness, and especially concerning those materials of lesser quantity, must give preference to the needs of combat soldiers.

5. Establishing a repository of blood forming stem cells: for serious radiation sickness caused by receiving large doses of radiation, transplanting of blood forming stem cells would appear to be the only effective method. If we directly transplant bone marrow or single nucleus cells from peripheral blood, they must all undergo histocompatibility locus antigen [system] (HLA) matching, which even if they match cannot completely do away with the occurrence of secondary infection, because it is still not completely clear just how many sites of human white cells there are. Only the HLA types of identical twins are completely identical. Therefore, more research is needed on this topic to gradually resolve the problem of overcoming transplanted

material resistance to the host disease when transplanting similar kinds of allogenes. At the same time, we must consider the establishment of a repository of blood forming stem cells, to store up beforehand in peacetime a rather large quantity of blood forming cells in liquid nitrogen for use in wartime. In addition to this we must also develop sources for blood forming cells, and we must store bone marrow, peripheral blood single nucleus cells and fetal liver cells. Moreover, when storing blood forming cells from different sources, aside from fetal liver, we must determine beforehand the HLA types for the bone marrow and peripheral blood single nucleus cells. This can be matched to the receiver only at the time of need, and is a prerequisite for transplanting blood forming stem cells. Therefore, it is necessary to set up repositories for blood forming stem cells, and is a fundamental construct for peacetime-wartime integration and military-civilian joint use.

The object of attack for nuclear weapons is not only units in warfare, but extends to the populace in the rear areas as well. Because the problem is complicated, this article has only made a brief discussion of the effects of casualties of instantaneous radiation on combat units, which is only one aspect of the problem for preventative atomic medicine, but which is also its main problem.

(manuscript received Jan 1985)

12586
CSO: 4008/348

LIFE SCIENCES

CURRENT MEDICAL COMPUTER APPLICATIONS

Beijing JIEFANGJUN YIXUE [MEDICAL JOURNAL OF CHINESE PEOPLE'S LIBERATION ARMY] in Chinese No 2, 20 Apr 85 pp 152-153

[Article prepared by Yang Youchun [2799 0645 2504], Nanjing Military Region General Hospital: "An Outline of the Conference Papers at the All-Service Specialist Symposium on Computer Medical Applications"]

[Text] The All-Service Specialist Symposium on Computer Applications in Medicine was held in Nanjing 10-14 Oct 1984. There were 136 papers submitted altogether, 106 were exchanged at the conference, and there were 2 reports on special topics. It was clear from the contents of the reports at this conference that all service computer applications in medicine have developed quickly, they have involved a broad range of areas, have already begun to probe and develop many other areas, and have been quite successful. Also, new specialist technology units are beginning to form that have both engineering technicians and medical specialists deeply involved and coordinated together. An outline of the conference papers is as follows.

1. Applications for Management and Quality Control

Among the various computer management applications are: hospital information management, as for example, the "Hospital Director Management System," the "Entire Hospital Computer Management System," etc.; management of drug materials, as for example the Ministry of Public Health's "Drug Materials Department Tasking Management System," "Hospital Drug Warehouse Management System," and the "Instruments and Equipment Management System"; specialist case management, as for example, for liver and gall surgery, burns, etc., "Specialist Cases Management System," and "Case Indexing Data Base"; quality control management, like "Interoffice Biochemical Quality Control Statistical Processing and Database," and "Control of Hospital Quality Management Indexes"; management of hygienic services, as for example, "Computer Modeling of the Process of Group First Aid Organization and Working" for wartime hygiene services.

2. Applications for Aiding Diagnosis and Pathogenic Analysis

Some units have already begun using computers for supplemental diagnosis of certain illnesses, as for supplemental diagnosis and pathogenic analysis of

illnesses of the heart, digestive tract, liver and gall, blood, brain surface, burn septicaemia, and oral cavities, as well as for prognostic analysis of heart disease, burns, and iron-deficiency anemia. Veterinary medicine has used them for aiding diagnosis of abdominal pain in horses.

3. Applications for Treatment and Automatic Control

For using computers in treatment supervision there are the "Monitor for Clinical Use of Drugs," "Heart Pulsation Instrument Diagnostic System," "Microcomputer Electrocardio Monitor," "Pocket Computer Heart Surgery Monitor," etc., all of which have raised the level of clinical treatment. As for automatic controls, there are the "Microprocessor-Controlled Automatic Tissue Dyeing Instrument," "High Pressure Oxygen Tent Computer-Controlled system," "Ultraviolet, Visible Light Spectrophotometer Automatic Analysis Device," etc., which have a clear effect on reducing labor, lessening manual work, and improving the quality of work.

4. Applications for Pharmacodynamics and Pharmacology

Using quantitative relations and mathematical modeling to study the process of change of drugs within the body, as for example, "General Formulas for Multiple Dose Linear Pharmacodynamics and Their Applications," "Calculations and Programs for Fitting M-M Removal Dynamics Parameters," "Applications for (Mai-kua-er-te) Algorithms in Pharmacodynamics Parameter Calculations," "A Computer Search System for Physical-Chemical Incompatibility of 104 Drugs for Intravenous Injection," "Programs for National Pharmacopoeia Bio-Assay," and "Quantitative Analysis of Structural Efficiency and Relations of 5-phenoxy-quinidine Derivitives and Anti-Malarial Activity," etc.

5. Applications for Processing Physiological Signals and Medical Graphics and Analytical Calculations of Data

Among the various computer applications in medical research concerning processing of physiological signals, parameters, and graphics, as well as analytical calculations of data, there are: "Obtaining Induced Potential from the Spinal Cord and Signal Analysis," "Computer Processing for Polycrystalline Gamma Cameras," "Automatic Computation of Eye tremor Electrographs," "Measurement System for Cardiac Muscle Functions," "Pulse Wave Microprocessor Analysis System," "Automatic Computer Analysis for Spontaneous Electroencephalograms," "Sequential Data Analysis of Nucleic Acids," "^{133}Xe Absorption Measurement of Partial Blood Flow Quantities," "Analysis of Visually Induced [eye] Position Charts," "Calculation of Decompression Tables for Repeated Diving," "Calculation of Decompression Tables for Tunnel High Pressure Work," etc.

6. Applications for Report Searching and Medical Statistics

Some units already use computers for library information resource searching, as for example the "Microprocessor Search System of Western Language Documents," "Retrieval of Documents on Naval Military Medicine," "Computer

Retrieval for Hospital Libraries," etc. Some units in medical statistics have already written "STB" and "SPMR" medical statistics program packages, with rather complete functions, and applicable as general software.

12586
CSO: 4008/348

LIFE SCIENCES

STRICTER HEALTH RULES FOR INTERNATIONAL TRAVEL

OW190914 Beijing XINHUA in English 0902 GMT 19 Jul 85

[Text] Beijing, 19 July (XINHUA)--Many people leaving or entering China from 1 August will have to undergo medical examinations to obtain health certificates valid for international travel, the Public Health Ministry announced today.

The certificate will be recognised internationally, a ministry official said.

Short-term tourists are not affected. But Chinese people who are going to stay abroad for more than a year and foreigners staying in China for longer than a year must have the check-ups.

Other people also covered by the new ruling include catering workers at transport facilities entering and leaving the country as well as at ports of entry and border points and car drivers and other transport workers crossing borders.

With the implementation of the policy of opening to the outside world, China's contacts with foreign countries have been expanding, said the official.

A record 25 million people crossed China's borders last year. A few foreigners in China and people returning from abroad have carried infectious diseases.

The new move is aimed at preventing the spread of such diseases, and protecting people's health.

The official said that from 1 August efforts would be made to improve hygiene at border points. Food crossing the border would also be inspected.

CSO: 4010/2010

LIFE SCIENCES

BRIEFS

PRC MEDICAL RESEARCH ACHIEVEMENTS LISTED--Beijing, July 16 (XINHUA)--In recent years, China's medical science research institutions have made great progress on exploring the causes of cancers of the esophagus, nose, throat and liver, the function of nitrosamine in causing cancer of the esophagus in the areas where the disease is recurrent, and the diagnosis and treatment of malignant tumors. Gu Fangzhou, president of the Chinese Academy of Medical Sciences and the Beijing Union Medical College, said today that by 1984, the academy had won altogether 515 prizes for research achievements. He was speaking at the closing ceremony of the second conference of the academic commission of the academy and the college. Gu said a research program into liver cancer undertaken by the cancer institute of the academy has just been appraised. Talking of the general situation of the country, he said, statistics show that the three most fatal diseases are cerebrovascular and coronary diseases and malignant tumors. The professor of virology said that the success rate in curing cancer of the chorion in China ranks among the first in the world. Gu Fangzhou said, China's fundamental medicine research is in progress. Gerontology and the pediatrics are drawing more and more attention. A decision was made at the second conference of the academic commission that 19 specialized committees would be organized, including those which research into lyphocytic hyhridoma, [as received] clinical pharmonology, [as received] biomedical engineering, genetic engineering, family planning, etc. [Text] [Beijing XINHUA in English 1802 GMT 16 Jul 85 OW]

CSO: 4010/2009

ENVIRONMENTAL QUALITY

BRIEFS

BEIJING DRINKING WATER REGULATION--Beijing, 3 July (XINHUA)--Beijing Municipal Government is taking measure to ensure the purity of the capital's major sources of drinking water. A 275 square kilometer area around Miyun Reservoir, which has a storage capacity of 375 million cubic meters, is to be kept free of pollution and waste and no buildings may be erected except those for water protection. Banned are swimming, boating, water sports or angling except in delimited areas, camping, picnicing and littering, as well as chemical, paper-making, dying and other factories that cause serious pollution. The regulation comes into force on 20 July. Violators, organizations or individuals will be heavily fined. [Text] [Beijing XINHUA in English 0735 GMT 3 Jul 85 OW]

CSO: 4010/2011

SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

SOVIET GEOLOGICAL DELEGATION VISITS CHINA

Beijing WUTAN YU HUATAN [GEOPHYSICAL AND GEOCHEMICAL EXPLORATION] in Chinese Vol 9, No 2, Apr 85 p 156

[Article: "A Soviet Geological Delegation Visits China--They Visited the Beijing Computer Center, the Geological Remote Sensing Center and the Beijing Geological Instruments Plant During Their Stay in the Capital"]

[Text] Based on the decision for an exchange of letters between the Chinese and Soviet governments, a Soviet geological delegation headed by V.A. Yarmolyuk, deputy director of the USSR Ministry of Geology, visited China from 27 December 1984 to 18 January 1985. The members of the delegation were Dr V.P. Fedortsuk, director of the All-Soviet Mineral Resources and Geological Prospecting Economics Research Institute; Dr K.A. Kleshev, deputy director of the All-Soviet Petroleum Geology Prospecting Research Institute; Dr V.M. Dolgopolov, deputy director of the USSR State Science Commission Mineral Resources Office; Dr A.O. Gliko, advanced researcher at the USSR Academy of Sciences Geophysics Research Institute; and Ye. V. Afanas'yev of the Soviet Ministry of Foreign Affairs First Far East Department.

Comrade Wen Jiabo [3306 1367 1405], deputy minister of China's Ministry of Geology and Mineral Resources, met with the Soviet geological delegation. Related areas of the Ministry of Geology and Mineral Resources systematically introduced the situation in solid minerals geology, petroleum geology, geophysical prospecting, geochemical prospecting and scientific and technical work in geology.

During their stay in Beijing, the Soviet geological delegation visited the Chiense Academy of Geology and its related research institutes, the Geology Museum, The Beijing Computer Center of the Ministry of Geology and Mineral Resources, the Remote Sensing Center of the Ministry of Geology and Mineral Resources, the Beijing Geological Instruments Plant and other units. Delegation member Gliko also made a special visit to the Chinese Academy of Science Geophysics Research Institute.

They visited the electronic computers and other equipment at the Beijing Computing Center and heard the results of using gravitational and magnetic processing and interpretation systems based on site conversion to process large amounts of data from northern China and other areas; the results of data processing and interpretation systems using electromagnetic wave methods to process the results of data from exploration of reservoir and heavy equipment

plants and other Karst work sites; the results of new methods using the Cyber-1724 computer to process seismic data such as broad-line results and so on; and the results of using the GC-1 and GC-2 to process regional geochemical prospecting data.

At the Beijing Geological Instruments Plant, they visited the gravitational instruments manufacturing workshop, the electronic instruments workshop and other workshops, they observed and understood several domestically-produced gravitation instruments and magnetic instruments and the new Model DWJ-1 laser electronics instrument, the Model XG-3 mercury measurer, the Models SY-2 and GGX-2 atomic absorption spectrophotometers and the XDY-1 dual channel atomic fluorescence analyzer and other equipment produced by the plant.

At the Geological Remote Sensing Center, they saw an S-101 computer plotting processor system, aerial infrared multispectral scanning systems, image developing and printing systems and other equipment, and they heard of the results of the application of remote sensing technologies in the area of the earth sciences in China.

Through their visit, the Soviet geological delegation expressed interest in the situation introduced by China and in the results that were exhibited. They felt that the levels were high and belonged in advanced world ranks.

Related comrades from the Ministry of Geology and Mineral Resources discussed some special topics with the related members of the Soviet geological delegation. At the request of the Ministry of Geology and Mineral Resources, delegation member Gliko gave a special introduction to related comrades in the Ministry of Geology and Mineral Resources concerning work at the USSR Academy of Sciences in the area of deep geophysical research. He introduced their research results and perspectives concerning the nature of the Conrad discontinuity, the nature of the Mohorovic discontinuity, the nature of deep low-velocity zones and other topics. They felt that the Conrad discontinuity may be caused by an interface between upper and lower rock that is of the same type but with different porosities and penetration coefficients. Most mathematicians feel that the Mohorovic discontinuity is a transition from basalt to eclogite and involves a chemical "transition." The low-velocity zone may be material that has relatively low viscosity and relatively high fluidity. There are two models for this type of material: one is a pattern of a liquid between solid particles, while the other is a pattern of solids in a liquid residue. His Chinese colleagues expressed considerable interest in his introduction. He expressed quite a bit of interest in developing deep geophysical surveys of the Himalayan Mountains in China.

Geophysical workers in the Ministry of Geology and Mineral Resources gave a complete set of WUTAN YU HUATAN for 1984 and a copy of "Abstracts of Sino-French Research Results in the Himalayan Region" to the delegation.

12539
CSO: 4008/362

AUTHOR: ZHANG Hanxin [1728 3211 0207]

ORG: China Aerodynamic Research and Development Center

TITLE: "Separation Criteria and Flow Behaviour for Three Dimensional Steady Separated Flow"

SOURCE: Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese No 1, Mar 85 pp 1-12

TEXT OF ENGLISH ABSTRACT: In this paper, the separation criterion and the flow behaviour near separation (or attachment) criterion is presented. It has been proven that the separation line (or attachment line) is a limiting streamline on the wall, and the neighboring limiting streamlines are convergent to the separation line (or are divergent to the attachment line), the separation line is not the envelop of limiting streamlines for the flows described by NS equations. In addition,the forms for flow separation, the behaviour of the singularity points on the separation line and problems of deciding separation line are discussed.

12949
CSO: 4009/219

AUTHOR: WEI Qingding [7614 1987 7844]

ORG: Beijing University

TITLE: "Experimental Research on the Turbulent Boundary Layer Separation"

SOURCE: Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese No 1, Mar 85 pp 30-38

TEXT OF ENGLISH ABSTRACT: This a shortened report on experimental research of turbulent boundary layer separation. Mainly taken from his own work, the author introduces the experimental methods and some important results on the turbulent boundary layer separation. The definition and measuring methods of backflow factors which expresses the characters of intermittent separation of turbulent boundary layer are given. The measured results of statistical quantities in the separation region-mean velocity, turbulence intensity are shown. The effect of velocity distribution of main flow on separation and the correlation between large scale motion in the turbulent boundary layer and intermittent separation are explained.

12949
CSO: 4009/219

AUTHOR: CHEN Qiongkang [7115 8825 1660]
JIANG Quanwei [3068 2938 0251]

ORG: China Aerodynamic Research and Development Center

TITLE: "Numerical Computation of Extended Kalman Filter and its Application to Aerodynamic Parameter Identification of Reentry Satellite"

SOURCE: Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMIC SINICA] in Chinese No 1, Mar 85 pp 96-100

TEXT OF ENGLICH ABSTRACT: This article describes some aspects of numerical computation developed to estimate the aerodynamic coefficients by means of Extended Kalman Filter, including optimized algorithm of solving the covariance matrix differential equations, computation of the Kalman gain and its correction, computation of the process noise and an independent varification using numerical derivatives, in order to save computer time and store as fully as possible. The mentioned algorithm has been applied to the aerodynamic parameter identification from flight data of one reentry satellite and yielded good results.

12949
CSO: 4009/219

AUTHOR: ZHU Ziqiang [2612 5261 1730]
CHEN Bingyong [7115 3521 3057]
ZHANG Bingxuan [1728 3521 2537]

ORG: Beijing Institute of Aeronautics and Astronautics

TITLE: "The Aerodynamical Calculation of the Wing Section With Separation"

SOURCE: Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese No 1, Mar 85 pp 13-20

TEXT OF ENGLISH ABSTRACT: A computational method of the flow around the wing section with separation is presented in this paper. The vortex sheet is used to simulate the separation wake. The strength of the vortex sheet is rationally selected. An"equivalent body" is formed by this vortex sheet with the attached flow region of the wing section. An iterative solution of the viscous/invicid interaction is used for this "equivalent body." The position of the separation point and the shape of the separation wake are simultaneously determined in the iterative procedure. Two typical wing sections have been calculated. The agreement of the computational results with the experimental data is fairly good.

12949
CSO: 4009/219

AUTHOR: XIN Dingding [1823 7844 1353]

ORG: Beijing Institute of Aeronautics and Astronautics

TITLE: "An Experimental Study of the Behaviour of 3D-Turbulent Boundary Layer In and Out of the Separation Region at Wing-Plate Junction"

SOURCE: Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese No 1, Mar 85 pp 39-47

TEXT OF ENGLISH ABSTRACT: An experimental study of the behaviour of 3D-turbulent boundary layer in and out of the separation region at wing-plate junction has been carried out at low and subsonic speeds. The measurements at ten stations located on two lines for the low speed tests and at two stations with one in and the other outside the separation region for the subsonic speed tests were arranged in order to get some fuller information about the distributions of three mean velocities and six turbulent stresses normal to the flat plate. The results show that the skew-induced "horse shoe" vortex formed in the separation region plays an important role in influencing the turbulent behaviour there. The method for processing data and the analysis of the experimental results including the effects of pressure gradient and curvature of streamline are also discussed.

12949
CSO: 4009/219

AUTHOR: WANG Zixing [3076 1311 5281]
WU Genxing [0702 2704 5281]

ORG: Nanjing Aeronautical Institute

TITLE: "The Effect of Winglet on the Spatial Vortex of Slender Body at High Angle of Attack"

SOURCE: Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese No 1, Mar 85 pp 49-53

TEXT OF ENGLISH ABSTRACT: The experimental investigation of the effect of winglet on the spatial vortex of slender body at high angle of attack is presented. This investigation clearly shows the circulation of the body vortex is minimized by the winglet and the vortex position is lower than that of without winglet, so that the asymmetric problem can be solved.

The method of fluorescent mini-tuft has been used.

12949
CSO: 4009/219

AUTHOR: SU Dingqiang [5685 1353 1730]
YI Meiliang [5056 5019 5328]

ORG: Nanjing Astronomical Instrument Factory, Academia Sinica

TITLE: "Some Discussions on Null Tests Using Compensators"

SOURCE: Beijing TIANTI WULI XUEBAO [ACTA ASTROPHYSICA SINICA] in Chinese Vol 5, No 2, Apr 85 pp 158-164

TEXT OF ENGLISH ABSTRACT: In this paper the concept of compensation to null tests using compensators in astronomical optics is advanced. As for Fig. 1, formula (1) and formula (2), if the parameters of the compensator A have been so selected as to yield $b_1=a_1$, only, we define it as the first order compensator. If to yield $b_1=a_1$ and $b_2=a_2$ simultaneously, we define it as the second order compensation, etc.

And we suggest three following principle points about the design of null test systems: 1. Because the selected focal ratio of the primary of modern reflecting telescope diminishes steadily, and more and more higher order aspheric systems of excellent image quality have been designed we should lay emphases on the second order, or higher order compensators in later design and research work. 2. The compensators should consist of small size optical elements. 3. Figures 3, 4 and 5 are the principle configurations for testing concave surfaces, convex surfaces and aspheric plates. In any above arrangements, B is a spherical mirror to converge the beam and A is a small size optical system providing the compensation of the requested order.

It is put forward in this paper that the applicable range of a compensator can be enlarged by shifting optical elements and changing object distance. Let's take the Offner compensator of Chinese 2.16-meter primary as an example. Its structure data are given in Table 1. When the refractive index changes from 1.5163 to 1.5313, it is only needed to change S_1 to --580.85785 d_2 to 505.45925 and d_4 to 12998.533. When e^2 of the primary changes from 1.0951347 to 1, it is only needed to change S_1 to --678.56510, d_2 to 504.25088 and d_4 to 12961.746. When the radius of curvature changes from --12960 to --13960, it is only needed to change S_1 to --607.29751, d_2 to 522.64348 and d_4 to 13990.144. In above cases, almost the same good effects of compensation are obtained. Even if the refractive index and the parameters of a primary change far more, very good results can be still obtained by changing S_1, d_2 and d_4 correspondingly. On the other hand, if the changes of the refractive index and the parameters of primary are small, it is already good enough by changing S_1 and d_4 only.

In addition, it is also mentioned that the better method is to compromise by defining a reasonable merit function for optimization during the later stage of the design process of null tests using compensators. The special program we developed for null tests is also introduced briefly. All results in this paper are obtained by the program.

12949
CSO: 4009/225

AUTHOR: DAI Minci [0108 3046 6337]

ORG: Guizhou Sanitation Monitoring Station

TITLE: "Environmental Geochemistry of Uranium in the Natural Protection Area of Mt Fanjing"

SOURCE: Beijing ZHONGGUO HUANJING KEXUE [ENVIRONMENTAL SCIENCES IN CHINA] in Chinese No 3, Jun 85 p 74

TEXT OF ENGLISH ABSTRACT: The investigation of the environmental geological factors, their changes and influences in the Fanjingshan Mountain Preserve has a positive significance for both the management and development of the area. The determination of the radioactivity intensity on the earth's surface of the area shows that the intensity is generally within the normal range set by the nation with the exception of some sectors of the area where the radioactivity intensity has exceeded the set standard as a result of the accumulation of uranium. From the point of view of geochemistry the uranium-rich geological body seems to be a "hidden pollution source" and attention should be paid to the possibility of the potential environmental pollution caused by it. In addition, proposal about the environmental protection and research work in the preserve has been suggested.

12949
CSO: 4009/2007

JPRS-CST-85-027
22 August 1985

AUTHOR: WANG Wenyu [3769 2429 3768]
DU Jinguan [2629 6855 6034]
XIANG Jingtian [7309 7234 1815]

ORG: Institute of Applied Mathematics, Academia Sinica

TITLE: "Threshold Autoregressive Moving Average Model"

SOURCE: Beijing JISUAN SHUXUE [MATHEMATICA NUMERICA SINICA] in Chinese Vol 6, No 4, Nov 84 pp 414-419

TEXT OF ENGLISH ABSTRACT:

In this paper, a new stochastic model of time series, the TARMA (threshold autoregresslve moving average) model, is proposed:

$$X_t = \sum_{k=1}^{P_{(j)}} \alpha_k^{(j)} X_{t-k} + \varepsilon_t^{(j)} + \sum_{s=1}^{Q_{(j)}} \beta_{t-s}^{(j)} \varepsilon_{t-s}^{(j)}, r_{j-1} < X_{t-D} \leqslant r_j, (j = 1,2,\cdots,)$$

The AR (autoregressive), ARMA (autoregressive moving average) and TAR (threshold autoregressive) models of time series can all be derived from this model under different conditions. A computing method for estimating the parameters of this model is given. Finally, a TARMA model is constructed using the data of the annual output of lynx leather in Canada. The results show that the number of the parameters of the TARMA model are fewer and the variances of the TARMA model are less than those of the TAR model constructed by H. Tong using the same data and that the predictions of the TARMA model are as good as those of the TAR model.

References

[1] H. Tong, K. S. Lim, Threshold Autoregression, Limit Cycles and Cyclical Data, *The Journal of the Royal Statistical Society*, Series B (Methodological), Volume 42, No. 3, 1980, 245—292.

[2] A. 拉尔斯登, H. S. 维尔夫著,徐献瑜等译,数字计算机上用的数学方法, §17.多重回归分析,科学技术出版社,1963,302—316.

[3] 王文玉,估计时间序列的自回归模型 AR(P) 及混合模型 ARMA(p, q) 的阶数——Bayes 估计,1981.

12949
CSO: 4009/1061

AUTHOR: WANG Pingqia [3769 1627 3174]

ORG: Computer Center, Academia Sinica

TITLE: "Method of Streamline Curvature for Calculating Transonic Flow Distribution in Turbomachinery"

SOURCE: Beijing JISUAN SHUXUE [MATHEMATICA NUMERICA SINICA] in Chinese Vol 6, No 4, Nov 84 pp 420-428

TEXT OF ENGLISH ABSTRACT:

Two problems of the Streamline Curvature Method for calculating transonic flow distribution are Considered: formulation of the boundary condition and selection of the root of $F(y)=0$. Three numerical examples are given. By comparison with the experimental data and the results of the time-dependent method, we conclude that the results of the Streamline curvature method for calculating transonic flow distribution give the correct trends.

References

[1] 吴仲华，机械工程学报，4卷1期，1956.
[2] T. Katsanis, Use of Arbitrary Quasi-Orthogonals for Calculating Flow Distribution on a Blade-to Blade Surface in a Turbomachine. NASA TND-2809, 1965.
[3] H. Marsh, Subsonic Flow in Turbomachine, *Computational Methodo and Problems in Aeronautical Fluid Dynamics*, 1976, 117—139.
[4] T. Katsanis, FORTRAN PROGRAM for Calculating Transonic Velocities on a Blade-to-Blade Stream Surface of a Turlomachine, NASA TND-5427.
[5] 中国科学院计算所三室，用流线迭代法解叶轮机械的气动问题、叶轮机械气动热力计算、设计与试验交流会文集，1976.
[6] 黄兰浩，关于流线曲率法，计算数学，1：4(1976)，27—47.
[7] 王平治，叶轮机械气动计算正问题和临界流量，数值计算与计算机应用，1：4(1980)，225—232.
[8] D. E. Hobson，设计跨音速涡轮叶片的速度图法，高负荷跨音速涡轮气动设计计算与试验研究(上集).
[9] 张耀科，沈孟育，龚增锦，关于用时间相关法求解平面叶栅跨音绕流的一些问题，工程热物理学报，1：4(1980)，337—340.

12949
CSO: 4009/1061

AUTHOR: LIU Dingyuan [0491 7844 0337]
ZHAO Yuqi [6392 3768 3823]
ZHAN Tingxiong [6124 1694 7160]
et al.

ORG: LIU of the Institute of Mathematics, Fudan University; ZHAO, ZHAN and et al of the Nanhua Powerplant Research Institute

TITLE: "Fair Fitting Methods Using Bezier Curves and B-spline Curves"

SOURCE: Beijing JISUAN SHUXUE [MATHEMATICA NUMERICA SINICA] in Chinese Vol 6, No 4, Nov 84 pp 420-428

TEXT OF ENGLISH ABSTRACT:

The authors provide two methods for fitting one-dimensional data points in computer aided geometric design: to fit the given data points with the least squares of the Bézier curve or cubic B-spline curve. To obtain the fair B-spline curve and to control the fairing and deviation, a fair weighted term is introduced.

References

[1] 刘鼎元,赵玉琦,詹廷雄,肖宏恩,叶片空间造型的计算几何方法,航空学报, 2: 4(1981),88—96.
[2] 周超骏,刘鼎元,船体数学线型设计,上海交通大学学报, 1981 年第 4 期,21—31.
[3] de Boor, C, A Practical Guide to Spline, Springer-Verlag, 1978.
[4] 李岳生,齐东旭,样条函数方法,科学出版社,1979.
[5] 苏步青,刘鼎元,计算几何,上海科技出版社,1981.
[6] P. Bézier, Numerical Control-Mathematics and Applications, John Wiley and Sons, 1972.
[7] 刘鼎元,胡康生, Bézier 曲面拟合,应用数学学报,7,2,1984,250—256.

12949
CSO: 4009/1061

AUTHOR: XU Guorong [1776 0948 2837]

ORG: Beijing Institute of Applied Physics and Computational Mathematics

TITLE: "An Unsteady Eulerian Difference Scheme for Arbitrary Polygonal Grids--A Modified Flic Method*"

SOURCE: Beijing JISUAN SHUXUE [MATHEMATICA NUMERICA SINICA] in Chinese Vol 6, No 4, Nov 84 pp 429-433

TEXT OF ENGLISH ABSTRACT: To set up the finite-difference equations in Eulerian fluid dynamics, in most cases the computing region will be divided by rectangular cells. In the present paper an Eulerian difference scheme for arbitrary polygonal grids is given. It is a modified fluid-in-cell method and can be applied to the flow problems with any complicated boundary shapes

*Received on 26 Oct 82

References

[1] 徐国荣,于志鲁,方振民,袁仙春,周淑荣,多物质可压缩流体力学的欧拉数值方法,数值计算与计算机应用,1: 3(1980),163—172.

[2] 徐国荣,于志鲁,廖振民,袁仙春,周淑荣,局部采用标志质点的流体网格法,力学学报,3(1982),207—216.

[3] 李荫藩,曹亦明,任意三角形(或四边形)网格的格子中流体方法,计算数学,3: 4(1981)381—385.

[4] R. A. Gentry, R. E, Martin, B. J. Daly, *J. Comput. Phys.*, 1(1966), 87—118.

[5] P. Roache, Computational Fluid Dynamics, Hermose, Albuquerque, NM, 1972.

[6] Nobuhiro Ukeguchi, Hiroshi Sakama and Taseshi Adachi, *Computers and Fluids*, 8; 2(1980), 251—264.

12949
CSO: 4009/1061

AUTHOR: SHI Xungang [2508 8113 0474]

ORG: Department of Mechanics. Beijing University

TITLE: "Numerical Simulation of Vortex Breakdown"

SOURCE: Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese No 1, Mar 85 pp 22-29

TEXT OF ENGLISH ABSTRACT: In the present work the breakdown of an isolated axisymmetric vortex embedded in an unbounded uniform flow is examined by numerical integration of the complete Navier-Stokes equations for unsteady axisymmetric flow. The results show that if the vortex strength is small, the solution approaches a steady flow and the vortex is stable and that if this strength is large enough, the solution remains unsteady and a recirculating zone will appear near the axis, its form and internal structure resembling those of the axisymmetric breakdown bubbles with multi-cells observed by Faler and Leibovich (1978). For appropriate combinations of flow parameters the flow reveals quasi-periodicity. Parallel calculations with the quasi-cylindrical approximation indicate that so far as the predicting of breakdown is concerned, its results coincide quite well with the results mentioned above. They both show that the vortex breakdown has little to do with the Reynolds number or with the critical classification of the up-stream flow, at least for the lower range of Reynolds numbers covered by the calculations of this work.

12949
CSO: 4009/219

AUTHOR: MA Yunli [7456 0061 7787]

ORG: Institute of Mechanics, Academia Sinica

TITLE: "The Global Solution of Magnetospheric Configuration for a Neutron Star"

SOURCE: Beijing TIANTI WULI XUEBAO [ACTA ASTROPHYSICA SINICA] in Chinese Vol 5, No 2, Apr 85 pp 110-116

TEXT OF ENGLISH ABSTRACT: In this paper we deal with the axisymmectric problem of steady-state global magnetospheric configuration of a neutron star in cylindrical coordinates. It is assumed that the magnetic axis is parallel to the rotation axis. The gravity, inertial force and particle collisions are neglected. After a nonlinear relation connecting the toroidal component of magnetic field with the magnetic flux function is reasonably chosen, the numerical approach gives the solution of the magneto-hydrodynamical nonlinear equations. The magnetosphere consists of the corotation region described by a linear equation and the wind region described by a nonlinear equation. The boundary face interlacing with both zones should be matched and is determined by iterative calculation. And then, the values of Ψ and a series of electrical and magnetic parameters are obtained. The solutions are determined first in the light velocity cylinder, then, extended to the region outside the light velocity cylinder, and the results of both regions give the global solution of magnetospheric configuration for a neutron star.

The solutions show that magnetospheric configuration of a neutron star is complex. The magnetospheric features in both regions are quite different. The magnetic force lines are closed in the corotation region, the magnetic force lines and charges are corotation with the neutron star. However, the magnetic force lines are open in the wind region. The electrons flow out from the region between the magnetic axis and the critical magnetic force line. The protons flow out from the ring region between the critical magnetic force line and the boundary of the corotation region. Eventually those positive and negative charged particles contribute steady state flows of equal magnitude. The magnetospheric characters in different regions are also discussed.

12949
CSO 4009/225

AUTHOR: CUI Hong [1508 1347]
HOU Yunde [0186 0061 1795]
DUAN Shumin [3008 3219 2404]

ORG: Institute of Virology, China National Centre for Preventive Medicine, Beijing

TITLE: "Increase of the Expression Level of Human IFN- D Gene in E. Coli"

SOURCE: Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese No 3, Jun 85 P 135

TEXT OF ENGLISH ABSTRACT: Human IFN-αD gene expression level in E. coli was increased by means of increasing the plasmid copy number successfully. A new plasmid pB V181 derived from pB V867 possessing ability to express human IFN-αD gene was constructed. It's IFN expression level in several different E. coli strains was also studied. Obtained results indicate that E. coli K12BMH71-18 is a ideal strain for pB V181 to produce human αD IFN. The IFN expression level of pB V181 was about five times higher than that of pB V867.

12949
CSO: 4009/2010

JPRS-CST-85-027
22 August 1985

AUTHOR: WANG Bingsen [3769 3521 2773]
DING Xuncheng [0002 6064 6134]

ORG: Workers' Health and Occupational Diseases Research Institute, Shanghai

TITLE: "Chronic Toxic-pathologic Investigation of Fluorocarbon Blood Substitute"

SOURCE: Beijing ZHONGHUA BINGLIXUE ZAZHI [CHINESE JOURNAL OF PATHOLOGY] in Chinese No 1, 30 Mar 85 pp 62-64

TEXT OF ENGLISH ABSTRACT: Fluorocarbon emulsion, a blood substitute, was injected once into dogs intravenously at 20 ml/kg. As a result, part of the substitute was deposited in the lympho-reticular system and was phagocytized by fixed and free histiocytes (monophagocytic system), and the histiocytes were then converted into foaming cells.

One month after the injection, the fluorocarbon's deposits in the foaming cells remained at the peak level in the liver, spleen and other organs of the lympho-reticular system. After six months, no deposits could be found in the viscera and no signs of any pathological changes were found except for the spleen under a light microscope. After 12 months, no foaming cells were found in the spllen, liver or kidney under a light microscope, but a few foaming cells were observed in the spleen and liver under the electronmicroscope; however, we believe that this observation is not pathologically significant in clinical practice. The target cells only showed the action of phagocitizing and depositing.

According to our observation, the fluorocarbon emulsion is a noncytoplasmic toxic agent that belongs to an inert biological substance, therefore no secondary histopathologic changes are caused by fluorocarbon deposition. It seems that 20 ml/kg of fluorocarbon emulsion injected intravenously is rather safe.

9717
CSO: 4009/256

AUTHOR: SONG Mutao [1345 1970 7118]
LI Xiaoqing [2621 0879 0615]

ORG: Purple Mountain Observatory, Academia Sinica

TITLE: "Fokker-Planck Equations For Magneto-monopoles and Charged Particles"

SOURCE: Beijing TIANTI WULI XUEBAO [ACTA ASTROPHYSICA SINICA] in Chinese Vol 5, No 2, Apr 85 pp 81-93

TEXT OF ENGLISH ABSTRACT: In the frame of non-relativity the Fokker-Planck equations for the interaction between magneto-monopoles and charged particles has been studied in this paper. According to the traditional dynamical method, we at first find out the trajectories of the collision between a monopole and a charged particle, and obtain the scattering angles during the collision, and then calculate the average deviations of the first order as well as the second order velocities, finally obtain the relaxation-times for the interaction between monopole and charged particle. The analytical representations of three different relaxation-times—slowing time, collisional time and energy exchanging time are given. Comparing these representations with those for the interaction among various charged particles, we find that the former is generally larger than the latter respectively by a factor of $(c\Gamma^{-1})^2$ (c—light velocity, Γ^{-1}—thermal velocity). Therefore the interaction between monopole and charged particle is usually weak. But in some astrophysical circumstances the influence of monopoles on charged particles cannot be neglected, and it is expected that the MHD equations should be modified adequately. Finally the closed MHD equations for the plasma containing magneto-monopoles are recited.

12949
CSO: 4009/225

AUTHOR: YU Yunqiang [0205 0336 1730]

ORG: Department of Physics, Beijing University

TITLE: "The Optical Appearance and Final States of Collapsing Charged Stellar Cores"

SOURCE: Beijing TIANTI WULI XUEBAO [ACTA ASTROPHYSICA SINICA] in Chinese Vol 5, No 2, Apr 85 pp 94-102

TEXT OF ENGLISH ABSTRACT: Here optical appearance of collapsing charged stellar cores is considered. In $Q < M$ cases, exponentially increasing redshift and exponentially decreasing intensity will be seen during the formation of charged black holes, just like the corresponding uncharged cases. The time constant could be prominently longer than that of the uncharged case. In $Q > M$ cases, if the naked singularity can be formed, one can see the infinite redshift and vanishing intensity after a finite time interval. However, the charged naked singularity seems unrealistic. Probably, a vibrating configuration will serve as its final state. Optically such as object shows a quasi-steady redshift which can be very large when Q is close to M.

12949
CSO: 4009/225

AUTHOR: Zhong Mingqian [6988 2494 0051]

ORG: Department of Physics, Northwest University

TITLE: "Approximate Correction to Formula of Quadrupole-Radiation Power of Gravitation from Rotating Stars"

SOURCE: Beijing TIANTI WULI XUEBAO [ACTA ASTROPHYSICA SINICA] in Chinese Vol 5, No 2, Apr 85 pp 103-108

TEXT OF ENGLISH ABSTRACT: The total power of gravitational radiation from rotating stars may be estimated by the well-known quadrupole radiation formula. However, in deriving the formula of quadrupole power radiated, the components of the stress energy tensor contain only term of rest-mass, which represents merely the effect of lowest order.

The aim of this paper is to improve the formula of total quadrupole power radiated from a rotating star. Expressions of the power radiated ("total luminosity") have been derived by Epstein and Wagoner [3] by means of post-Newtonian approximation of the components of stress energy tensor containing terms of rest-mass, kinetic energy, potential energy and internal motion of the source. We apply their formulae to the gravitational radiation of a star rotating in the Newtonian limit.

12949
CSO: 4009/225

AUTHOR: JIANG Shiyang [5592 0013 0111]

ORG: Beijing Observatory, Academia Sinica

TITLE: "The Period Changes of BW Vul"

SOURCE: Beijing TIANTI WULI XUEBAO [ACTA ASTROPHYSICA SINICA] in Chinese Vol 5, No 2, Apr 85 pp 117-122

TEXT OF ENGLISH ABSTRACT: BW Vul is a Beta Cepheid type variable with rather high amplitude. We made some photoelectric b band and y band observations during 1982 to 1983. From these observations, we determined 5 times of maxima. A quadratic ephemeris based on all observed maxima implies a 2.2 sec. secular increase of period per century. The O(O-C) calculated from this quadratic formula of ephemeris

$$T_{max} = \text{HJD } 2428802.6770 + 0.201029577E + 7.158 \times 10^{-11}E^2 \qquad (2)$$

shows a variation with a probable period of 26.3 years and an amplitude about 0.022~0.024 days. An observational evidence obtained in the evening on November 18, 1983 tends to show that BW Vul may be in an eclipsing triple system, the inclination angle i of the normal of the orbital plane should be 90 degrees. From this, we find the eccentricity $e = 0.52$, and the mass of the unseen companion system $m_2=(1.07\ 1.18)M_\odot$, the distance between the centre of mass and the unseen companion $a = 19.1$ 20.8 A.U. The angular separation would be 0.02~0.04 arcseconds if we take the visual absolute magnitude $M_V = -4.0\sim-3.0$. So, it can be detected by speckle interferometry with the largest telescope. It can also be detected by fine observations made succesively in many years with an accurate photoelectric radial velocity spectrometer. Of course, it is very useful if we monitor it once photometrically each year in the future. These observations will verify the behavior and will certify the period of this long time scale variation.

12949
CSO: 4009/225

JPRS-CST-85-027
22 August 1985

AUTHOR: XU Ke [1776 4430]
CHEN Lijun [7115 7787 4596]
JIANG Mingshi [3068 2494 1853]

ORG: Shanghai Institute of Physiology, Chinese Academy of Sciences

TITLE: "A Binding Characteristic of Neurotoxins from Bungarus fasciatus Venom to Acetylcholine Receptor"

SOURCE: Shanghai SHENGLI XUEBAO [ACTA PHYSIOLOGICA SINICA] in Chinese No 2, Apr 85 pp 155-161

TEXT OF ENGLISH ABSTRACT: The crude venom of Bungarus fasciatus was fractionated by ion-exchange chromatography on a CM-Sephadex C-50 column into 11 fractions. Two neurotoxic fractions obtained were further purified on CM-Cellulose C-32 and Sephadex G-50 columns. They were basic proteins and were named neurotoxin I (TI) and neurotoxin II (TII). Both lacked phospholipase A activity. A test of neuromuscular transmission on a chick biventer cervicis nerve-muscle preparation showed that both TI and TII belonged to the post-synaptic type. The mouse minimal lethal dose (i.p.) of TI and TII was about 200 r and 250 r per kg body weight respectively.

The competitive inhibitory effects of the two neurotoxins on the binding of ^{125}I-bungarotoxin and ^{125}I-cobrotoxin to AChR were studied. After preincubation of the narcine AChR (Triton X-100 solubilized extract or the preparation further purified by affinity chromatography) with various amounts of TI or TII (for 10 minutes or 1 hour), ^{125}I-bungarotoxin or ^{125}I-cobrotoxin was added and the residual binding of the latter to AChR was determined. The results showed that even with excessive amounts of TI or TII, the total binding of α-bungarotoxin or cobrotoxin to AChR was only competitively blocked about two-thirds of the time. The possibility of two kinds of AChR existing is discussed.

9717
CSO: 4009/2000

AUTHOR: QIN Zhimin [6009 2535 3046]

ORG: PLA Hospital 303

TITLE: "Roentgen Manifestation of Shipman's Blast Injury"

SOURCE: Beijing ZHONGHUA FANGSHEXUE ZAZHI [CHINESE JOURNAL OF RADIOLOGY] in Chinese No 2, 10 Apr 85 p 79

TEXT OF ENGLISH ABSTRACT: A series of cases with shipman's blast injury was reported. Eight patients had injury involving both lower extremities and two involving one side. All were classified as solid blast injury or solid concussion injury. The blast wave is generated from the underwater explosion which hits the warship producing instantaneous violent shaking of the latter and inflicting damage to the shipmen. Those parts of the human body in direct contact with the steel board suffer the most, hence injury of the lower extremities with fracture is most serious and presents certain clinical as well as radiologic characteristics. The fracture lines of the calcaneous, tibia and femur are in accordance with the gravity line. Platypodia is frequent after healing of calcaneal fracture.

12949
CSO: 4009/2008

- END -